SCIENCE EDUCATION

H. EMMETT BROWN

VOLUME 43 APRIL, 1959 NUMBER 3

SCIENCE EDUCATION

THE OFFICIAL ORGAN OF

National Association for Research in Science Teaching
Council for Elementary Science International
Association on the Education of Teachers in Science

CLARENCE M. PRUITT, EDITOR
University of Tampa
Tampa, Florida

Manuscripts and books for review as well as all communications regarding advertising and subscriptions should be sent to the Editor.

SCIENCE EDUCATION: Published in February, March, April, October, and December.

Subscriptions $5.00 a year; foreign, $6.00. Single copies $2.00; $2.50 in foreign countries. Prices on back numbers furnished upon request.

Publication Office: 49 Sheridan Avenue, Albany 10, New York

Second class postage paid at Albany, N. Y.

VOLUME 43 APRIL, 1959 NUMBER 3

CONTENTS

Continued on page 284

SCIENCE EDUCATION

VOLUME 43 APRIL, 1959 NUMBER 3

H. EMMETT BROWN

When considering the individual to be honored in this science education in foreign countries number of *Science Education,* only one name seemed at all appropriate. No other American in the science teaching field has made so rich and extensive contributions to education in foreign fields as has Dr. H. Emmett Brown. This is true whether the contributions be measured in terms of years, in terms of extensive contacts with a number of foreign countries, in terms of good will created between the United States and the specific country, or in terms of the actual educational progress resulting from the contacts made. The writer often wonders whether or not a considerable per cent of the money spent abroad is not in many instances very poorly spent or even wasted. Undoubtedly much of it is wasted through poorly planned programs, through allotments where not actually needed, through gross corruption by persons in charge of the aid, and so on. Too often resentment and even hate seems to have been created rather than a feeling of good will toward the United States and an understanding of the American way of life and America as it really lives, believes, and acts. Without question more value is received, for each dollar spent, in the educational programs assisted than in any other aspect of the total foreign aid spending program.

Held in high esteem and dearly beloved in each country in which he has served, Dr. Brown has made not only visible contributions, but as important, and probably even more so, are the intangible contributions of good feeling and better understanding created and fostered. Dr. Brown has been ably assisted by his wife, Mrs. Ruth Margaret Owen Brown, formerly of Washingtonville, New York. The Browns were married June 29, 1922. They are the parents of two children. A son, Hugh Sheldon Brown, born in 1923, was killed in an automobile collision in 1953. A daughter, Marcia Mary Crosman, lives with her husband, John H. Crosman, Jr., and their three children, in Orleans, Massachusetts.

Dr. H. Emmett Brown was born in Grand Rapids, Michigan, April 28, 1897, the son of Frank Holmes Brown, M.D. and Leola Schwingle Brown. Dr. Brown graduated from the Dansville, New York, High School in 1914. He earned a B.S. degree from the University of Rochester, Rochester, New York, in 1918, and M.A., (1929) and Ed.D. (1938) degrees from Columbia University.

Teaching experience includes teaching in night school (1915–1918) while still an undergraduate; teacher of mathematics, Kemper Military School, Boonville, Missouri, 1918–1920; elementary school mathematics and science, Peekskill Military Academy, Peekskill, New York, 1920–21; Science and mathematics, Ridgewood, New Jersey, High School, 1921–1928; science in Lincoln School of Teachers College, Columbia University, New York City, 1928–1944; instructor in natural science, Teachers College, Columbia University, 1928–1944; summer session, Stanford, University, Palo Alto, California, 1936; professor of science and Head of Science Department, New York State College for

Teachers, Buffalo, New York, 1944–1952; Fulbright Lecturer, State Training College for Teachers, Rangoon, Burma, 1950–1951 (on Sabbatical leave); Education Officer, Mutual Security Mission to China, Taipei, Taiwan, 1952–1957; Chief, Education Division, U. S. Operations Mission to Afghanistan, Kabul, Afghanistan, 1957 to present.

Dr. Brown was a member of the committee that produced the Progressive Education Association report (1934–1938) *Science in General Education.* During 1935–36 he served as Research Associate with the Progressive Education Association Commission on Secondary Curriculum. He was Curriculum Consultant (1935–1938) for the Wilmington, Delaware, Public Schools. During 1951–52 he appeared in a series of thirteen programs on WBEN-TV. on *Science in the Home.* He has served on numerous committees both in America and the Far East.

Dr. Brown was Vice-President (1949–50) and President (1950–51) of the National Council for Elementary Science. He is a member and Fellow (1944) of the American Association for the Advancement of Science; National Association for Research in Science Teaching; American Association of University Professors (President New York State College for Teachers Buffalo Chapter, 1946–47). He was chairman of the Science Section of the New York State Association of Teachers Colleges, 1944–1946. He is listed in *Who's Who in American Colleges.*

Publications include the following articles and books:

"The Plight of High School Physics (a series of eight articles) in *School Science and Mathematics,* June, 1939–February, 1941; "Mathematics and Physics," *Science Education,* November, 1941; "Aerodynamics" and "Navigation," a weekly series of articles (anonymous) in *Current Aviation,* 1943–44; numerous other articles dating back to first article published in 1928, but titles and magazine not recalled.

Books, bulletins, and chapters in books and bulletins include:

Science in Pre-Flight Aeronautics, C.A.A. publication, 1942; Chapter on physics teaching in *Forty-Fifth Yearbook of the National Society for the Study of Education,* 1946; "Trends in High School Courses in Integrated Physical Science" in *The Bulletin of the National Association of Secondary School Principals,* 37:83–91, January, 1953; "Community Schools of Taiwan" in *Education for Better Living,* Bulletin, 1956, No. 9. U. S. Office of Education, p. 215–229 (with Isabelo Tupas and Henry Yang; contributed articles to *Compton's Encyclopedia* and the *Wm. H. Wise History;* Co-author (with Maxie Nave Woodring and Mervin E. Oakes) *Enriched Teaching of Science In the High School,* Bureau of Publications, Teachers College, 1928–1941; *The Development of a Course in the Physical Science for the Lincoln School,* Bureau of Publications, Teachers College, 1939 (also title of Doctoral Thesis); Co-author (with S. Ralph Powers) *Workbook in Physics,* Allyn and Bacon, 1932 and 1946; Co-author (with Schwachtgen) *Physics: the Story of Energy,* D. C. Heath and Company, 1949; Laboratory Manual and Teacher's Manual for *Physics: The Story of Energy.*

Dr. Brown's philosophy of teaching is reflected in four of his articles in *School Science and Mathematics* entitled "Water-Tight Compartments," "Peccant Psychology," "Mismanaged Mathematics," and "Social Implications." Ideas discussed in these four articles are:

1. That science teaching should show the interrelations between the various divisions of the subject. Emphasis should be placed on integrating concepts that "ramify throughout" (in a well-known phrase) the material. The energy theme is one such in the field of physics.

2. That science teaching should begin with the material of most immediate interest and proceed from that most immediate, both spatially and ideationally, to the more abstract and more generalized ideas. It is because of this belief that I find myself out of sympathy with recent curricular ideas in the field of physics, that place such a strong emphasis, to the exclusion of much ma-

terial of value and interest, upon electronics and waves.

3. That the utilization of mathematics in science, and particularly in the field of physics, should be used as a tool for the clarification of ideas and the showing of relationships. Mathematics is not included for the sake of the additional rigor that it may give to the subject.

4. That the practical values and social implications of science should be stressed. In the community school project, discussed in the article, science took on a practical service function for the community. The importance of such facts as that the average worker is rated at but 1/10 horsepower, while in the U. S. each industrial worker has the equivalent of many slaves of installed mechanical power available for his work, should be stressed.

To these must be added a fifth i.e. that for beginning students in science it is the methodology of science that is, in many respects, more important than its content. It was that that I had in mind in the Taiwan incident recounted in the article. It is because of this, that in physics text so much emphasis is placed upon the inductive method for the generalization of physical laws.

In a hundred-page 1957 Republic of China National Educational Materials Center publication entitled "Report on U. S. Aid Education Projects, 1953–1957" on professional education, vocational education, community school education, and overseas Chinese education, each of the nine articles is by a Chinese author who was intimately involved in the project from its early days. One paragraph is pertinent to the present article:

The compilation of this report was about ready when Dr. H. Emmett Brown, Chief of the Education Section of the Mutual Security Mission, announced he would leave Taiwan for his home country. Dr. Brown has served as head of the Education Section ever since its establishment nearly five years ago. With his invaluable experience in the field of education he has made great contributions in assisting in the operation of the various programs. His sincerity and enthusiasm in his work have won the respect of all who know him. This report is presented to Dr. Brown as a momento of his fine service in China.

Dr. Brown was an outstanding leader in American science education field before starting upon his extensive foreign service tour. An outstanding classroom teacher of science both on the high school and the college level he had been very active in the National Association for Research in Science Teaching, the Association for the Education of Teachers in Science, and the National Council for Elementary Science, serving as Vice-President and President of the latter organization. He had also attained wide recognition through many articles and as an author of books. This rich background of teaching experience, leadership in scientific and teacher organizations, and as an author, made him an outstanding person to assume responsible educational obligations in the Far East. Here, with his great capacity for work, his genuine interest in, and sympathy for the people with whom he has worked and associated, he has not only added to his own prestige but to that of science education as well. He and Mrs. Brown have been outstanding representatives of America in the Far East. Both have travelled extensively in the Far East aside from their assigned area of tour. No other American science education leader so thoroughly knows both the Far East and American educational set-ups, the social, economic, and political points of view, and how each culture may make its best contribution to the other. So to a noted world leader in science education is made, most befittingly, the Sixteenth Science Education Recognition Award.

Clarence M. Pruitt

IMPRESSIONS OF SCIENCE TEACHING IN THREE COUNTRIES

H. EMMETT BROWN

U. S. Operations Mission to Afghanistan, Kabul, Afghanistan

FOREWORD

THE fact that this present article is being written is a tribute to the perseverance of Editor Dr. Clarence M. Pruitt who has been urging me for some years to chronicle my impressions of science teaching in three countries: Burma, Taiwan, and Afghanistan in which I have worked.

I have resisted his pleas partly through native indolence and partly because as time has gone on, I have felt less and less competent to write what he wanted.

The point is that while I served as a Fulbright science lecturer in Burma in 1950, and returned to my previous college science position for one academic year thereafter, when I entered Foreign Service in 1952 it was in a non-teaching capacity. Thus, I find myself in the peculiar position of having the most vivid impressions of science education of the country in which I served first, and know the least actually about science teaching in my present post in Afghanistan.

The actual record of these years of foreign service runs as follows: In 1950–51, I was science lecturer in Burma attached to the State Training College for Teachers in Rangoon. Returned to my college job as head of the Science Department at the New York State College for Teachers at Buffalo in the fall, I found myself looking back on my Burma experience with a good deal of nostalgia. The feeling grew that perhaps in 1955, I might ask for leave of absence again for another foreign service whirl. I put out some tentative feelers, Washington-wise, and filled out some forms. One day in March 1952, my phone rang and a strange voice said, "How would you like to go to Formosa?" It was not quite as simple as all that but eventually I did go to Formosa, or Taiwan as it should be called, to become the first education office in the MSA mission there. In Taiwan, I had the satisfaction of seeing a program of assistance for Chinese education develop.

There were projects in vocational-industrial and vocational-agricultural education involving schools and involving teacher training for those schools. There was a very interesting project in which we were assisting the Chinese Government to bring overseas Chinese from countries such as Thailand, Indonesia, and Viet-Nam to Taiwan for their education. There was a community school project, perhaps the one dearest to my heart as it was the only one which had to be sold to the Chinese and to Washington. Other projects there were too, but these were the main ones. It was the community school project that afforded me my chief contacts with science teaching. Finally, after nearly five years in Taiwan and the completion of two tours, in accordance with ICA policy, I was to be transferred to a new post.

Paraguay was under consideration for a time and then Afghanistan—and Afghanistan it became. No developing of new projects in a beginning office here. Rather the backstopping of already-existing projects in teacher training, English teaching, vocational-agricultural and industrial education and in college agriculture and engineering. A group of projects not all in the Education Division undertake to provide assistance for Kabul University in its construction program. In Taiwan there had been a rather sizeable office group of Americans and capable Chinese assistants, all working directly for the Mission, with two relatively small university contract teams outside. In Afghanistan, just the reverse. Two very large contract teams—Teachers' College, Columbia and Wyoming Univer-

sity—probably the largest anywhere, and the very minimum of Mission supporting staff—a secretary and myself. Under these conditions the time that can be spent in field work and in any incidental observations of science teaching have been small indeed.

COUNTRY EXPERIENCES

This cannot pretend, then, to be a systematic survey of science teaching in the three countries. As to be expected, I will take the opportunity to generalize upon science teaching conditions as I believe them to be. But first, if for no other justification than as anecdotes, let me cite experiences in each of the three countries.

Burma

The State Training College for Teachers in Rangoon had two practice high schools on its campus. In one of these, a college student, a girl was explaining the quantitative composition of water. She had no apparatus before her and she spoke in Burmese, but she did have a large chart of the Dumas-Berzelius experiment. Thus, I was able to follow what she was explaining. From this came an educational experiment. I prepared a test in English which would check on the students' understanding of the facts of the experiment and of the conditions which must exist in order to ensure accurate results. Thus, a student had to decide whether it was necessary that all the zinc in the hydrogen generator be used up or that all the copper oxide in the combustion tube be converted to copper. There were also checks on the consistency of answers through the use of several items dealing with different aspects of the same idea. All of this ran to two long typewritten pages. When translated into the round Burmese characters, the test ran to about double its original length in English. We gave it to both high school students in this class and to the college chemistry class from which this teacher had come. Results? Not what you would expect at all. The high school class greatly outperformed the college group. Why? One could suggest reasons. The high school group had just been over the material. The college group had it some months before. But the college group had had laboratory work, the other had not.

Taiwan

On several occasions in Taiwan, I had a chance to work with groups of teachers on methods of teaching science. On one occasion, I was trying to demonstrate the method of problem-solving in science teaching. I brought to the class as apparatus simply two identical newspapers and rolled them up to make tubes each about 2 inches in diameter. I then shortened one tube by tearing off about half, and explained to the class that they were to be used in a test on hearing. A blindfolded student held one tube over each ear extending out at right angles from his head. Moving quietly so as not to reveal my presence, I clicked two coins together in the median plane directly in front of the subject's nose and asked him to indicate the apparent direction of the sound. He pointed towards the side on which the shorter tube was held. We reversed the tubes and repeated the experiment again. Again he thought the sound came from the side with the shorter tube. We repeated with other subjects with the same results. Then the teachers were asked to select theories which might explain this result, and were tested on facts they needed to know in order to verify the theory. A number thought you needed to know the speed of sound in the metal of the coins. Others that the conduction of sound by paper was involved. Then, teachers were asked to describe further experiments they might perform to check the favored explanation theory. Not a single member of the group, some of them science teachers, could suggest an experiment. Surely a commentary on the traditionalism of the teaching.

Afghanistan

In Kabul, the capital city of Afghanistan, the four chief boys' academic high schools teach different foreign languages. One, Habibia, and the oldest teaches "American" English. A second, Esteklal teaches French; Nedjat, German; Ghazi "British" English. In the past, and to a certain extent today, much of the instruction including that in science has been in these various foreign languages. At Esteklal I observed a biology class being taught in French by a Frenchwoman, while next door an Afghan taught Chemistry in Persian.

Regardless of the language, the curriculum in these schools and in other academic schools in Kabul and in other cities follow the French tradition. Physics, for example, is taught in all six years of the complete academic school (grades 7–12). The general pattern is that of going through the subject once in grades 7–9 and then of going over the ground again in grades 10–12 with a general review in the last year. A similar pattern is followed in the case of Chemistry, but Biology is taught in five grades only. In the 10th grade, boys study Geology in its stead, and girls Home Economics.

In schools in which it is working, the Columbia Team is experimenting with general-science courses patterned along American lines. Whether a modification of the Afghan science program along American lines will eventuate from this experimental teaching remains to be seen. Certainly there are strong proponents of the present European-type curriculum among Afghan science teachers.

COMMON FEATURES OF SCIENCE INSTRUCTION

Science teaching evidently differs greatly in the three countries. One is impressed, however, with the existence of a number of common features.

1. *Memoriter Learning.* In all these countries, there is a great tendency to learn things by rote.

In Burma, colleges were dismissed for the last month of the school year in order that students might cram for examinations. The cramming consisted of memorizing large portions of the text.

2. *The Use of the Lecture Method.* Too commonly, instruction at all levels is by lecture. With the use of the lecture method goes a naive belief that if a topic is only mentioned it can be considered to be covered. One hears objections to the discussion method since by its use, "you cannot get over as much ground"—an objection not unknown to the United States.

3. *Science Equipment.* During the years, I did see what I thought to be an increase in the use of apparatus for demonstrations in laboratory use. But on too many occasions, equipment seemed to be for display rather than for use.

In Burma, science teachers were bewailing the fact that much of the apparatus had been broken during the war. They were trying to get back to the conditions that had existed under the British rather than to take the opportunity to plan for new apparatus and look to the needs of their present teaching. In both Burma and Taiwan, equipment was too often small and toylike rather than larger and more practical. In Taiwan, though, there were many instances of teacher or student-made equipment.

4. *Formalism in Science Teaching.* In all three countries, there is much standing erect during recitation and of recitation in unison. This seemed particularly true in Taiwan and Burma where it almost seemed as though the teacher measured the effectiveness of her teaching by the volume of the student unison response.

5. *The Content of Science Courses.* This is usually theoretical and not as closely related as it should be to the conditions of the country. Thus, in Burma, a great rice producing country, the elementary science curriculum carried a unit on mushrooms but had no appreciable amount of material on rice.

The students in Burmese science classes would have some experience with simple machines but no understanding, I am sure, of the significance of the fact that the average Burmese uses only about 150 KW hours of energy per year in business or leisure activities while the average citizen of the most favored countries uses over 10,000 KW hours of energy annually.

6. *Language*. This is a problem in much of the science teaching since the native tongues are often deficient in the technical terms that are needed. These terms are often adopted directly from a foreign language, usually English. Attempts to render technical terms into the local language may yield ludicrous results. Students in a chemistry class in Rangoon using a text adopted into Burmese thus came up with the idea that hard water and ice were the same thing. It is because of this problem that several oriental countries have instituted societies often called "Translation Societies" whose function is to determine how scientific terms should be represented in the native tongue.

7. *Centralization*. Strong centralization is characteristic of the educational system in all these countries. The UNESCO Educational Mission Report on Afghan Education in 1952 said:

> "Finally it must be said, however, reluctantly, that the elementary school system of Afghanistan is highly centralized with no apparent educational reason for the degree of centralization."

This may be said of secondary education also.

This centralization has the effect of maintaining the teaching of science in unchanging patterns and of discouraging experimentation in science teaching. In schools, such as the community ones in Taiwan where local initiative is encouraged, however, this is reflected in the fact that science courses make much greater use of local resources and have undergone adaptation to better serve the needs of the community.

8. *Teachers' Salaries*. Science teachers along with all teachers in the three countries of my experience are poorly paid. So poorly paid, that many of them feel impelled to seek other positions to eke out their income. This goes up and down the line from the science classroom teacher to the head of a college division. The pay of the teachers is unbelieveably low, running as little as a starting salary of only about 4,000 Afghanis (about $190 per year at the official rate) per year for a college graduate in Afghanistan. To this, however, must be added certain additional benefits all civil servants receive.

In Taiwan, teachers characteristically were given free housing, food, and health benefits. But even with these considerations, the teaching salaries are very small and constitute a block to educational advancement.

9. *Improvements*. The previous eight points have pointed to situations which, in the main, are less than desirable. But there are bright spots in the science picture. One sees forces in action which over the years cannot help but effect improvements. The former great Head of the Department of Public Instruction in Rangoon, now unfortunately dead from an automobile accident, remarked to me on one occasion, "I want to get some joy in science teaching." There are many of his sort—persons who desire to make science at once more practical and more attractive to the student. Perhaps one of the finest experiences in Taiwan was in noting how in the community schools, as time went on, the science instruction was modified to make its contribution to the improvement of community life. Chemistry classes were helpful in developing fertilizers and insecticides; biology classes helped in the study and treatment of chickens infected with disease or in the attack on the all too prevalent trachoma.

In Afghanistan, through the work of the Institute of Education, improved science materials are being developed and teacher practices improved through inservice training. In recent years text books have been developed in English and in Persian for

grades 1 through 8 and other materials are in preparation.

Perhaps most heartening of all is to see the instances of science teachers who, perhaps working without too much encouragement, have gone ahead on their own to effect improvements in their science teaching and to arouse the interest of their students. Science teaching would be furthered if the work of these outstanding teachers could be given further recognition by the Government, possibly through increased pay or in any case by recognition of their achievements by the Ministry of Education or by a national organization of teachers.

PARTICIPATION IN EDUCATION OF SECONDARY SCHOOL SCIENCE TEACHERS IN EGYPT

SAMUEL RALPH POWERS

Professor Emeritus of Natural Sciences, Teachers College, Columbia University, New York, N. Y.

THE circumstances attending the appointment "to lecture in Egypt on Methodology of Teaching Science" were not unusual. The initiative was in a letter from Executive Secretary on International Exchange of Persons saying: "The Committee has been informed . . . that Abbassia Men's Teachers Training College has expressed an interest in your coming to the College as a guest professor . . . under the 1954–55, Fulbright Program. The proposal has the endorsement of . . . the Egyptian Minister of Education who has in addition requested that you be available to the Ministry as an adviser and consultant on education in the secondary schools."

Following receipt of appointment, a letter came from the Dean of the college at Abbassia in which he said: ". . . your work here should be primarily with members of the staff of the Education Department. . . . You will hold seminars with both staff and students and give occasional lectures in your area of specialization." The work undertaken was in general agreement with these instructions except that a good share of time was given to staff members in the Science Departments as well as to the Education Department.

Abbassia is a division of Cairo. The college had been opened in September, 1952. There were other colleges for men and there were colleges or institutes for education of elementary school teachers, but this college was unique in that it was a four-year teachers college for prospective high school teachers of science. It was "higher" in the sense that it was for the education of high school teachers. Students were entered directly from high school. Tuition was free and there were enough applicants to allow some measure of selection. The administration of the college was directly responsible to the Ministry of Education and was not attached to a university.

In Egypt as elsewhere there was a severe shortage of teachers of science and mathematics. This was true in spite of over-population and a high level of unemployment. Appointments of teachers were being made from emergency sources. A most obvious function was to contribute to reducing the shortage, by encouraging students to enter studies other than those leading to the overcrowded professions. A second function was to serve as an agency through which reforms might be introduced in teacher education and in turn as innovations in secondary schools.

The curricula of elementary schools, secondary schools and colleges were in many respects a single curriculum. A good number of Egyptian educators had studied in England and in France and had adapted the curriculum patterns of these countries to their own schools. In secondary schools

there was emphasis on "liberal" education "to give a reasonable degree of exercise and development to the whole of the faculties." This objective was to be realized in the comprehensive secondary school through study by all students of the usual academic subjects including classical Arabic (which was the language of publication throughout the Arab world) and one or two foreign languages, of which English was foremost. This curriculum supported "for exercise of the faculties" had become rigidly set in syllabi and in education and attitudes of teachers. There was interest among educators in making changes in this traditional pattern and in increasing the scope of secondary education to include other objectives.

The founding of the college was contemporaneous with the change in the Egyptian government that came with the overthrow of the Monarchy and the deposition of the king (July 27, 1952). The objectives of the Revolution were, among others, to increase industrial and agricultural production, improve health and well-being, raise the level of literacy and of understanding of common observations. These objectives of the Revolution were incorporated at once with the objectives of public education.

Several outside agencies had established activities in Egypt, some with support from United Nations, others were supported by the United States government. All these agencies were interested in advancing much the same objectives. The close coöperation of Egyptian people with these agencies was an eloquent testimony of their respect and friendship for the West and of their agreement with western ideals and objectives.

There was a ready response from Egyptian educators and from educated people generally to the challenge to initiate changes in the government and in the schools. Egypt had been long under control of an outside power. Now they were reminded by their political leaders that, as an outcome of the Revolution, they had gained the privilege and the responsibility to plan independently and for themselves, that is to raise issues and make and abide by decisions.

A good number of Egyptian educators, with subsidies from their own government, had studied abroad and during more recent years many had studied in the United States. Most of them had undertaken doctoral studies and after completing their work had returned to positions of leadership. At the same time young men had come and were coming to America for advanced studies in medicine, dentistry, engineering and agriculture. After our arrival associations were re-established with our former students in science education and through them, there was opportunity to meet, both socially and professionally, with other educators and their families. In these friendly relations there was free exchange of ideas and common efforts to achieve the objectives of the International Educational Exchange Service.

After this renewal of old acquaintances and making new ones and after an interesting program of orientation, it seemed easy and natural to begin work at the college. The Dean offered his definition of the purpose of the College: "to make a teacher of science, not just a man of science." In the prevailing circumstances it was important and indeed inevitable that the objectives of the Revolution should be recognized in interpreting the objectives in the college. The "teacher of science" more than "the man of science" should recognize the usefulness of science in social and economic advances.

During their first two years in college, the students' work is centered on science and mathematics, a foreign language—either English or French, history and social studies, and other liberal subjects. A course in dramatics, including production of plays was popular. Professional courses in education were offered beginning with the third year. Student teaching, done mostly in the public schools of Cairo, began during the third year.

The immediate tasks of the science facul-

ties of the College was to review and to consider revisions of syllabi and course outlines, especially for their third year work. There were no textbooks available in the Arabic language for use in courses. In this new college and in Egyptian colleges generally instruction was given by lectures and students used their lecture notes to prepare for examinations.

Field work was an important feature in the work of the college. There were zoological and floral gardens with beautiful displays of plants and animals both native and exotic and in their natural habitats. The geology of Egypt and of other regions was well displayed in a geological museum. Agricultural and mineral products were well displayed in appropriate museums. Trips were taken to centers of community activities. Two days were allowed for a trip to a much publicized and very important irrigation project for reclaiming waste land from the desert. Another important project was one in building Rural Welfare centers in which initiative from local communities was assisted by grants from the Egyptian government. Activities concerned with health and sanitation, agricultural and industrial production, and community living,—supported by United Nations and United States government—were also centers of active interest.

The quarters of the college are in an old mansion with some additional rooms of recent construction. The science departments were housed in the new rooms. Laboratory equipment seemed fairly adequate. Library facilities were quite inadequate partly because of lack of space. Shelf space was inadequate for display of the limited number of books available. This inadequacy was a matter of much concern and measures to enlarge the Library and to make its facilities more easily available were in progress. Several conferences were held on use of audio-visual materials. These were accompanied by showing of films and discussion of teaching technics.

The Dean accepted with some reservations a suggestion to consider the purchase of American textbooks for use in beginning college classes in chemistry, physics, botany, and zoology. There was some eagerness on the part of members of the staff to examine texts that might be considered for use in their classes. Some books were assembled with assistance from the librarian of American University in Egypt, and the librarian of American Embassy. Unfortunately the books readily available were not recent and were not representative of best practices. The suggestion under consideration was that books in English be purchased, one for each student in beginning classes. There were some misgivings, other than financial, about the wisdom of this undertaking. Even though it was abandoned the examination of these books, guided by the motivation that they might be selected for use, was an important educational activity for those who had not had ready access to textbooks either in their work as a student or as a college instructor.

Plans for extending the scope of the college into a comprehensive college with programs for education of all secondary school teachers, and for a new building were under discussion. Members of the staff who had studied in America knew something about the state supported colleges in the United States. Catalogs of selected colleges were assembled for examination. An interpretative memorandum was prepared. These preliminary discussions may have effects on future planning.

The faculty of education was much concerned with improvement and extension of counseling and guidance. An examination of high school records showed, that, by American standards, there were too many student failures, that the high schools were oriented toward preparation for college and a professional career, or a career in government. Many of those who graduate from high school will fail to gain entrance to the colleges of their choice. It may be noted, too, that many who succeed in graduating

from college and professional schools do not find remunerative employment in the profession for which they have prepared. The problems associated with counselling and guidance are made complex by overpopulation and a low level of income.

The method followed in communicating with the Egyptian educators may best be described as that of a consultant. There were many individual and group conferences with men who were active in determining educational policies. They welcomed the opportunities to exchange opinions with Americans as they did with other people. Through their many contacts with the West there were common understandings and a ready meeting of minds. An effort to evaluate the efforts of this consultant in terms of actual changes made during the year would yield but little in the way of finished reports and positive conclusions. It seems reasonable to assume, however, that the many conferences on topics of common interest did effect their thinking as they did ours and will influence action in any situation when similar or related issues are raised.

For an American and his wife, this was an experience of living in close relations with the people of another nation and another background of culture. It was our privilege and pleasure to know them as individuals and friends, as Egyptians and Moslems, some as Copts; and to know them in their families, and in their social as well as professional living. Similarly, they had opportunity to know us as friends, and as Americans and Christians; to visit us in our home and to gain some notion of the background of our social and professional living. Each of us learned something of the historical and social background of the other, and gained respect for the other's attitudes, ideals, and beliefs.

Their interests, and ours, were in contributing to better understanding, as a means to advancing the levels of health, education, and general well-being. Many of the issues that come into their lives as they seek to advance their own interests, are partially or even totally different from issues affecting us, depending upon cultural and social factors. Progress toward advancing our common interests will surely be accelerated through cooperation in advancing common understandings.

INTEREST IN NATURAL HISTORY TEACHING IN NEW ZEALAND, FIJI, ENGLAND, NORWAY, SWEDEN, AND DENMARK

E. Laurence Palmer

Director of Nature Education, The American Nature Association, Washington, D. C.

Many years ago when I taught in the Middle West, a member of our faculty took a trip through Europe one summer. On her return, she gave a series of talks on "The Pestalozzi System as I Saw It in Germany." Investigation disclosed that the only time she was in Germany was when she went through a corner of it one night in a sleeper. In part because of my former associate's experience in foreign lands including her quick trip through Germany she became a member of the predecessor of our present Office of Education. I always grinned when I heard her speaking as though she spoke with authority. I have every reason to suspect that some may grin when I attempt to speak to the title of this paper.

I pretend to some understanding of some of the teaching practices associated with natural history in New Zealand, Fiji, England, Norway, Sweden and Denmark because in recent years I have visited these places with the intent of learning something of what was going on in this field there. I spent over five months in New

Zealand as a Fulbright teaching Fellow, two days in Fiji with a government forester, two weeks in England for the most part with the British Museum of Natural History and at the Royal Agricultural College, a week in Norway and Sweden as a purposeful tourist and about three weeks in Denmark as a participant in the International Congress on Zoology in 1953 and as a representative of four professional groups from America at the 1954 meeting of the International Union for the Protection of Nature. I have measured these experiences against a background of some years of science teaching in America from Hawaii to New England and from border to border. I was a charter member of the National Association for Research in Science Teaching and to tell the truth I was delighted recently to have heard that one of our newer members remarked that Palmer "didn't know what science education was all about." I admit that for reasons of my own I have not found it too profitable to be a regular attendant and participant at these meetings in recent years but if we can both overlook this situation for awhile I may be able to give you some of the impressions I have had relative to science teaching in the countries with which we are here concerned.

It is my understanding that a once prominent New York politician once sought as a reward for political service his appointment as ambassador to New Zealand since he understood that they spoke the English language there. I found when I landed in New Zealand that I had to learn my native tongue all over again. Commenting on the small number of persons in a sleeping car I said that I noticed that we were travelling "light" only to have my seatmate comment that on the contrary we were "right on time." I found that in New Zealand as in America in some schools "biology" meant the study of living things. In others it meant reading from books about things that lived or had lived. I once listened in a teacher training college there to a filmstrip talk about geomorphology with accompanying slides only to notice that outside the classroom the students could have seen from their very seats even more spectacular examples of the subject under discussion. This reminded me of the time a soil demonstration agent in New York State tried to show in a tent on a bright sunny day slides of soil phenomena that were equally good in the immediate environment. The same man gave a lesson on the effect of rain on soil by using a watering pot in front of a fire place in a camp lounge because it was raining outside and the trip could not be taken.

Somehow I felt from my New Zealand experience that a surprisingly large number of the average classroom teachers were as well or better qualified than their American counterparts to carry on successful outdoor experiences. In fact I felt some of them were better qualified to do this than many of those who train science teachers in this country.

A surprisingly large number of the teachers in elementary schools in New Zealand are men and I have not seen equalled here some of the teaching a few of those men did. One in a school near Christchurch did a remarkable job with a class of boys working in a garden. He could name most of the important organisms that were brought to his attention, could tell what their economic importance was and could direct most skillfully the activities of the children so that they did find out for themselves many worthwhile things. I have many times wished that I might take that man to an American teachers meeting such as this let us say, for the mutual benefit that might result from the experience.

I found that for the most part the supervisors in science at the precollege level were superior individuals so far as their mastery of science was concerned though it was quite possible as is the case with our teachers that they were not uniformly trained in all fields of science.

One New Zealand trainer of science

teachers was most ambitious to appear erudite. He requested me to demonstrate before a class a lesson on seeds and fruits and to show how such a lesson might touch on the various fields of science such as cytology, morphology, physiology, taxonomy, and economics. As I remember he urged me to get deeply involved in the subject. This sounded like a challenge but it developed that in the first place he did not know the differences between seeds and fruits although it was about them that he wished me to "go to town." Judging from American elementary and secondary science texts this blind spot is common here.

Fortunately this inquiry came to me early in my New Zealand experience and I found it worth while to build on it in my subsequent meetings with other groups. I even carried this to such a point that we involved consideration of the relation of survival of plant seeds and fruits being associated with color blindness in birds and mammals. I put problems to the members of my audiences and hoped that they would try to solve them on their own. I got many letters giving me my answer and as the plane was about to leave the country I was handed two letters by a prominent government official from children who lived nearly a thousand miles apart giving me the proper answer. The answer could have been found in no book and the New Zealanders seemed to like to be stimulated to self activity. Judging from the sustained correspondence I have had for ten years I believe that it was a satisfactory experience all the way around.

In a number of cases I found as I have found in America that the New Zealanders knew major generalizations with little understanding about the basic principles involved or on how they might be demonstrated. I visited one high school that was a converted American school I believe. There was an abundance of intricate electrical equipment which the students were being taught to use but neither staff nor students seemed to know how to make a simple electromagnet.

During the time I was in New Zealand I rather deliberately divided my time into thirds. One unit I put on getting to know the country from travel and observation. Another portion I put in observing how New Zealanders taught. The remaining third I put in giving instruction myself. During the time I was there I visited and taught in each of the three major units of the University of New Zealand, in each of the five teacher training colleges and in private and public elementary, secondary, and vocational and correspondence schools. I visited schools in the centers of population and out in the "bush." I saw some excellent school plants and in one rural school could have studied the soil a few inches beneath the broken floor of a classroom. In the corner of that classroom lay a freshly removed pile of wallaby hides.

I confess I was amused to visit one rural vocational school and to see the teacher of agriculture and carpentry at his labors wearing an academic gown. In the halls of the universities it was a common sight to see the professors speeding down the halls with their academic gowns flowing behind them. I visited one small private school where the principal wore his gown throughout my visit. When I visited an elementary room I was pleased to see him down on his knees in front of a blackboard helping a second grade child with his arithmetic problems. I felt that while the staff felt a creditable dignity in their profession they were not in the least snobbish about it. This situation may have been created by the typical experience of a beginning teacher who in a rural school may find that he is not only the teacher but the janitor, carpenter, and gardener as well.

Let's take a quick glance at the New Zealand school system as it appeared to be to me when I was there in 1949. A qualified man student who is 17 years old and who can pass an acceptable examination may be admitted to the teacher training college.

A training school student who is under 21 years of age receives from the government approximately $400 a year with possibly an extra hundred as a boarding allowance. If the student is unmarried and over 21 he would receive about $800 a year through his period of training. If he were married he would receive about $900 a year. A typical boy's experience might run something like this. At 17 he would receive $400 a year as a student in training. At 19 he might be a probationary assistant at $650; at 20, a junior assistant at $900; at 22, an assistant in a district high school at $970; at 30, a senior high school assistant at $1300; at 35, a head teacher at $1800; at 40, an inspector at $2300. The retiring allowance after 40 years of service would be about $1700. For a woman the starting income would be the same as for the boy but the income at 40 would be about $1850 and the retirement income after 30 years of service $1000.

At the university level professors receive approximately uniform salaries wherever and whatever they teach and irrespective of travel, experience, success or other factors. This as I remember it was about $4500 a year. Working within this economic framework it is obvious that teachers are limited in their opportunity to travel and to enjoy luxuries yet I found few if any who did not seem tremendously happy because of their opportunity to teach. Under these circumstances it is obvious that within our economic viewpoint teaching in New Zealand is really a labor of love, a calling. Possibly because of this we find teachers who are dedicated to their profession and this seems to be true whether or not the teacher teaches science or some other subject.

Of course any economic picture is relative. As I remember it I got a haircut for about 20 cents and one could get a hotel room and three good meals (if you were on time) for about $2.50 a day. The room would not be heated in the middle of winter but that was almost universally the case, and I do not remember once being really warm while I was in the country. A new Ford (if you could get one) cost comfortably over $4000 as I remember it. As a result New Zealand teachers drove British cars if they drove any.

On the whole I was favorably impressed by the members of the teaching supervisory staff. As I remember it, there were approximately a hundred supervisors of teachers of nature, science, and agriculture. Most of these men had strong extra-curricular interests which usually contributed to their effective service and some times to their income, at least from the garden. One spent most of his time assisted by his wife in studying the home life of penguins and albatrosses. He wrote a book entitled "Sexual Behavior in Penguins" which was published by the State of Kansas. He probably got no financial return whatever for his efforts and little professional recognition as a teacher but he was tremendously pleased to have made his contribution to science. On the other hand one of the major directors of research in the country told me that he never worked over the legal 40 hours a week and yet his field of investigation was matched by no other in its significance to a sustained economy for his country. It is barely possible that he was "pulling my leg" but I doubt it.

New Zealand's record as to the use of their natural resources is one of which they should be both proud and ashamed. The country which about equals our Atlantic Seaboard in size and shape and in distance from the Equator may be divided conveniently into three equal parts. One third is rugged mountainous country with peaks rising over 12,000 feet in a land where the sea is rarely if ever a hundred miles away. This area serves a most important function in providing a rainfall which is essential to the economy of the country. Another third is primarily grazing land and as such provides the backbone of the livestock industry. The remaining third is low arable land for the most part once covered with

dense forests most of which have now disappeared. This land is capable of producing tremendous plant wealth at a spectacular rate. Erosion due to overgrazing is serious and is little appreciated and frequently denied. Forest and mineral resources have been prodigally wasted. Exceptional water and thermal power have gone undeveloped. Many of the indigenous plants and animals have become exterminated but there is a dynamic and intelligent interest in preserving many of the plants and animals now facing extinction. One science teacher established in his school yard an excellent plantation showing his students from living specimens what might be found in different parts of the country.

In an area comparable in size to our Atlantic Seaboard there is a population about equal to that of Manhattan and less than that of Brooklyn. In the future with expanding populations to the North this garden spot of the world may well be faced with the necessity of defending its present opportunity of maintaining a reasonably high standard of living. I believe that it is capable of doing this if they become sufficiently alert to the situation in time to meet the situation.

I found in New Zealand, as in many of the other countries visited, a naive understanding of things American. One New Zealand college educator propounded the idea in all seriousness that American education was geared primarily to permitting college graduates to live a life free of labor of any kind. I believe I straightened him out.

On my return from New Zealand I stopped off for two days in Fiji. I wish I might have spent my whole time there and I hope to go back sometime. I had friends there whom I had met years before in Jamaica who helped me make the most of the opportunities to be found there. Possibly most interesting of these contacts was a forester named Colin Marshall. He had undertaken almost single handed to educate the country as to the importance of its woody resources. He had recruited a group of high school students who became so interested in forestry that they built their own forestry school. In its environs the forester had established experimental plantations designed to improve the production of the more valuable forest materials. He did this deliberately to help shipping lines that had to bring products to the country so as to have available adequate exports to sustain a two-way economy. He was faced with a phenomenal problem due to interracial activities where the native Fijians and the exotic Indian populations had conflicting backgrounds, ambitions, abilities and habits. I was impressed by the way he almost single-handedly developed a functional science education suitable to the situation in which he found himself. I regret that I cannot here elaborate that story because it is worthy of further consideration. If the New Zealanders had difficulties that would discourage the average American science teacher the problems faced by this Fijian forester would probably be completely discouraging. Imagine my surprise August 1954 to meet Marshall again in Copenhagen where we were attending the meeting of the International Union for the Protection of Nature. Even more startling was the fact that since I was in Fiji he had been moved to Malaya where his difficulties were even greater. If he survives the few remaining years before his retirement I believe he might have a story to tell science teachers that might be well-nigh unbelievable. If we may judge the effectiveness of his work from what I saw of him in Fiji I have every faith that somehow or other he will come out on top.

And now we come to the European story. My visits there during the 1953–54 summers for a total of some seven weeks are almost wholly inadequate for the making of a significant report. Yet the opportunity I had to meet strategic individuals in fortunate situations may have well corrected the handicaps of a short time. I am convinced that in Europe there is a strong group of

scientists dedicated to the teaching of a sound science program and confident that through such a program some of the causes of international misunderstanding may possibly be considerably reduced. As I interpret our American literature we smugly believe that we lead the world in science education. Current articles in *Science Education* and the *Journal of the National Education of the United States* tell of the enormous progress we have made in the last 25 years in science education and of the superiority of our American schools over those of Europe and yet the report of the Summer Conference on Science Education held at Harvard University in the summer of 1953 states that there has been no appreciable expansion of work in physics and chemistry since 1930 and indicates that there has been a marked decline in the number of college graduates prepared to teach mathematics, biology, general science, physics and chemistry for 1949–53. How these statements can be reconciled with the praise that has continually been heaped on the yearbooks that have been reputed to have stimulated successfully science teaching enormously I fail to see. In view of the critical situation so far as the war manpower in science and engineering in America is concerned I fail to see how we can have much pride in what we have been doing for the last 25 years and I am glad that during that period I have continued to be highly critical of much of the popular philosophy in science education.

During the summer of 1954 in Copenhagen I had the opportunity of serving as educational chairman of a group representing Sweden, Austria, Canada, Germany, Peru, Holland, Great Britain, and the United States and on another committee that involved these countries and Denmark, France and Yugoslavia. This was at the meeting of the International Union for the Protection of Nature where there were about 200 representatives of over thirty nations. The discussions were in French and in English and we worked in the field with Norwegians, French, Italians, Russians and Belgians. Basing my impressions on experiences at these meetings and on subsequent correspondence with leaders met there I believe that we have much to learn from these citizens of other countries and that much of our self confidence is unjustified. As a result of these associations over the years I was asked by the I.U.P.N. to prepare a booklet on the teaching of conservation based on the recommendations of the Caracas Conference of 1952. In this I attempted to induce youngsters to do things in science which were significant particularly in the field of conservation. The booklet has been translated into French and Spanish for use in the schools of countries using those languages. We are now working on another project for the Union which may also serve the science teaching field on a broad international basis. This report should be ready for the next meeting of the Union in Scotland in 1956. It is quite possible that this international effort might be integrated with the expanding educational service of the National Wildlife Federation. Last year the Americans whom we contacted directly with this program and from whom we get financial and other support exceeded a million and at the recent meeting in Montreal a closer association has been established with similar programs in Canada. If we can help these foreign countries without impairing our recognized obligations to our own country, we feel that this is practically an obligation in these times of international stress and strain.

Possibly the strongest bond which seemed to exist between conservation education in America and in many of these other countries was tied in with scouting activities. In 1953 there were some 50,000 scouts and scouters in attendance with representatives from many countries. We feel that during the session we gave at least 1½ hours of instruction in the field to 28,000 scouts and scouters. This I am sure is conservative. This was followed in 1954 by the scout conservation good turn in which widespread application of sound conservation practices

was put into effect. There is reason to believe that this program will be continued and eventually incorporated in the regular scout program. When that time comes there will be continued opportunity for science teachers to do some effective teaching providing they are prepared to do so. This will in many cases call for the establishment of some new interests and for the revision of some established philosophies which I believe are now held by many.

I was somewhat surprised at the degree to which Europeans were informed on what we were doing in conservation through the scout program and there is evidence that what we are doing there may well serve as another link that may lead to good international understanding. I am sure that scouting is not fully appreciated as a possible vehicle for a practical science education by most of our professional science educators. I am confident from what I saw in Europe through the eyes of teachers and of scientists that what we are doing for science and conservation through scouting and our national conservation programs is better known than what we are doing in science education. Whether this is desirable or not is a matter of personal opinion.

At Valley Forge in 1957 we gave field training in forestry, soils, and wildlife to 34,500 scouts, and in 1960 at Colorado Springs we expect to exceed this number tremendously.

I could present here digests of the many papers I heard given showing how science is being taught in the schools of other countries but hardly feel that this is within the province of this report. I could list some of the books and other publications prepared for various countries for use by their teachers of science and many of them are excellent but it is too long a story to introduce here. Some of the most spectacular work seems to be being done in Japan though I doubt if it excels some of the better work done in America.

I am sure that in the field of sensory aids and techniques of teaching through use of such aids we have much to give other nations and more than I believe we are likely to receive. I witnessed a leading Russian scientist try to discuss the details in a 5x7 print on the wall below his shoulder height while he stood with his back to an audience of 400 and spoke in rapid Russian. It was as effective as some of the lectures I have heard in some American universities! If the activity of this Russian is evidence of what Russia is doing in effective mass teaching through sensory aids I doubt if we have much to fear from them but I understand that their teaching technique does not follow the progressive philosophy that a child must not be made to do what he does not want to do so I doubt if we can brush off the Russian menace too lightly.

I found in most foreign countries that I visited a rather naive understanding of things American as I have already stated. One group seemed to think that their economic future was assured because of the sale they might expect from a rather mediocre film strip. This of course was to be sold for use in American schools where commercial firms often make contributions of superior materials of instruction. Some of the sensory aid material I saw Down Under would match anything I had seen anywhere up to that time.

One of the most interesting experiences in my exotic meetings comes closely to members of this group to whom I am speaking. On the last day of the I.U.P.N. meetings the summer of 1954 a science teacher from America leaned across the table and whispered to me "Why is it that so few of our science teachers in America get this philosophy? It is just what they need." I first met this teacher at a meeting of the National Science Teachers here in America and knew that she is well informed in the field of science education. I agree with her completely but doubt if we will get far in satisfying our hopes. One of the great tragedies of professional meetings is the degree to which the group gets together

year after year to hear the same people develop the same philosophy. I know of one group of zoologists where year after year two men get on the program talking about the same subject year after year with only a slight variation in the figures given each year. For many years I found similar rewards in attending meetings in the field of science education. I am sure that professional educators need to be less provincial not only geographically but professionally. I could speak rather intimately of one group that started a few years ago as a small committee of a major group. Year after year they met as a committee and now they are pulling loose from the parent group to hold their own meeting and will lose all the advantages they had through working with academic scientists as well as with professional educators. I think it is a serious mistake but doubt if my views are heeded. It is too easy to stay in an established groove even though the groove may lead away from where you want to go. I am sure that many of the shortcomings that can be readily identified with professional science educators here and abroad would never have developed if each planned deliberately to spend a reasonable proportion of his convention time working outside the field of education and in the field of academic science. I really wonder what proportion of this group in the last year have attended meetings that would advance their understanding of science as they have in attending meetings concerned with what is known as science education. I for one have been much happier when I have deliberately mixed these two aspects of professional improvement than I was during the years when I emphasized either the one or the other. Sure we discuss international aspects of science education in meetings such as this but every one of us would widen his professional horizon and make fewer inexcusable mistakes if we increased our understanding of science as such.

I have emphasized in this paper my experiences in New Zealand, Fiji and Denmark. I regret that time does not permit equal emphasis on England, Norway, and Sweden where I had most stimulating experiences. Some of the laboratories I visited in Sweden were equipped far better than any of their counterparts I knew of in America. Every science teacher who visits that country should spend a day in the Linnaeus country and following his footsteps and yet I saw the name of but one American whom I knew in the guest book at his former home. In Norway there was less evidence of rich equipment for the teaching of science and much evidence of rancor over experiences in the last World War. In Oslo for example it was a bit startling to visit the Nobel Institute dedicated to Peace and then a few minutes and blocks away visit the Town Hall. This, however, is life and having been on the ground helps one understand some of the things that may be seen at international meetings elsewhere. The same might well apply to what I saw in England where conservative and progressive viewpoints crowd each other for recognition. If time permits I may elaborate on these points following the reading of this paper but we in America have much to give and much to receive in strengthening our international understandings and relationships. Without such development we are lost.

SCIENCE EDUCATION IN THE PHILIPPINES

EARL R. GLENN
Fulbright Lecturer in the Philippines *

I. A TROPICAL ENVIRONMENT FOR EDUCATION

WE must consider first some basic facts of the environment in the Philippines which determine educational policies and practices.

The Republic of the Philippines is composed of 7,100 islands located Southeast of Asia between latitudes 21° North and 4½° North of the Equator. It is a short journey by air to Formosa from the most Northern islands and a very short trip to Borneo from the most Southern islands.

These islands beyond the International Date Line extend from East Longitude 127° to about 117° East of Greenwich. A long trip must be taken by a luxury liner or a freighter to reach this part of the world. To reach the Philippines by air travel, the long way, the trip is about as follows: A person must ride in a Stratocruiser from mid-morning until dinner time to reach Honolulu from San Francisco. A second day's flight will take the tourist from Honolulu to Wake Island beyond the International Date Line. After dinner on a small island, one may fly to Guam and reach this island at mid-night. After an hour or so in Guam, the Pacific crossing is resumed. Between four o'clock and five o'clock in the morning, the street lights of Manila can be seen from the windows of the Stratocruiser. The Manila airport is about 14° North of the Equator.

The islands of this Republic are the tops of a submerged mountain chain of volcanic origin. To reach them, we have to cross about 7,000 miles of the Pacific Ocean between San Francisco and Manila. On the West side of the Philippines, there is more salt water, the South China Sea. To the South we find the Celebes Sea. There are no large land masses near the Philippines. Only rarely does a continental air mass from Siberia and China reach the central or Southern islands of this nation.

The air is warm and very humid in this part of the world. The average temperature is 80° F. There are very few extreme variations at sea level. The humidity is above ninety per cent in the early morning and may decline to 65 per cent in mid-afternoon. The average rainfall is recorded as 90 to 100 inches per year. However, there are great variations and some localities have vastly greater annual precipitation. The city of Manila, for example, had 54 inches of rainfall in the month of August, 1952. Rainfall in the path of a typhoon may be very heavy, indeed.

In these tropical islands there is no spring; no winter; no autumn. There is the wet season with a few, or perhaps one dozen or two dozen typhoons each year from late June to December. There is a hot season during April and May when there is very little rainfall. These months are the vacation weeks for teachers and students. There is a cooler period during January and February when the rainfall is greatly reduced. At this season the climate may be very delightful, indeed. During these cooler months, the week-long athletic games are held in the school districts; in the provinces; in the regional contests; and in the national interscholastic finals. The town fiestas and the public celebrations in schools and colleges are usually held in these more pleasant months.

* The writer as Fulbright Lecturer in the Philippines was assigned to the faculty of the Central Philippine University, Jaro, Iloilo City, Panay, July 1952–March 1953 and to the faculty of Philippine Normal College, Manila, Luzon, April 1953–April 1954. Brief visits were made to Iloilo Normal College, Visayan Central College, Philippine Women's University, Far Eastern University (Manila), and Zamboanga Normal College.

II. SOME IMPORTANT HISTORICAL FACTS

In considering the present-day educational program and problems of this nation, we must mention some facts of history. Magellan discovered the Philippines March 16, 1521. Twenty-one years later, the Spanish moved in and retained control of the islands for 350 years. In 1899, the islands were made the responsibility of the United States. William Howard Taft was appointed the first governor-general in 1901. The Tydings-McDuffie Act of the U. S. Congress arranged for complete independence of the Philippines in 1946.

In the meantime, World War II spread over the islands of the Pacific Ocean and the Japanese military forces invaded the Philippines on December 8, 1941. In October, 1944, the U. S. military forces returned to these islands and Manila was liberated from the Japanese in February, 1945. Then, at long last, the Republic of the Philippines came into existence on July 4, 1946. In the long period of history from 1521 to the present, the Filipinos, themselves, have had full charge of their schools only since 1946.

The damage to public and private education during the recent war (1941–1945) must now be considered:

1. Many school buildings were destroyed or badly damaged.
2. All books, magazines, newspapers, and scientific apparatus were burned or otherwise destroyed. It was almost impossible to find books or magazines published previous to 1946 or 1948.
3. Many teachers did not return to the schools. Other teachers were called upon to help reestablish local, provincial, or national governments.
4. The capital city of Manila remained only a tangled mass of ruins.

III. PRESENT STATUS OF PHILIPPINE EDUCATION

Briefly, the conditions that prevail in 1955 may be described as follows:

1. The public and private school systems have been reestablished as a result of almost super-human activities on the part of government and school officials, teachers, and the organizations of parents and teachers.

There are really two parallel systems of education in the Philippines. There is a Bureau of Public Schools. In addition, there is also a Bureau of Private Schools. Both of these Bureaus are under the direction of The Secretary of Education, a cabinet officer appointed by the President.

As might be expected, there is great centralization of authority in the two Bureaus in Manila. All courses, all policies, all appropriations for the Bureau of Public Schools, all publications for official use must have prior approval by the Secretary of Education.

2. In a population of about 22,000,000 there were some 4,000,000 pupils enrolled in 19,200 elementary schools. In about 1,300 high schools, there were approximately 600,000 students.

3. In private schools, whether owned by individuals or churches, tuition is charged in both elementary schools and secondary schools.

4. The term, "public schools," has a restricted meaning in the Philippines. Tuition is charged in public schools. Many families are unable to pay these tuition charges and pupils drop out of school. There are no effective laws for compulsory attendance, in the face of these required tuition charges, in both public and private schools.

5. The program of elementary education before World War II covered a period of seven years. Since the war only six years have been used in the schools below the high school. However, the seventh school year is to be restored.

In speaking of students in high school science, in this discussion, we will be thinking of the seventh, eighth, ninth, and tenth school years in the life of a Filipino boy or girl.

6. We must deal, now, with the influence of the physical environment of these islands on the languages of the people. Eight basic languages are recognized in the Philippines. More than eighty dialects are derived from these eight fundamental patterns. Other

nations have this great variety of languages. In a recent article in the *New York Times Magazine,* Mr. Bowles [1] states that there are at least fourteen languages spoken by the 340 million people living in India.

The language of instructon in the Philippines in nearly all schools and colleges is English. However, there are some recent developments. The National Congress in Manila passed a law requiring two years of Spanish for a high school diploma. (Contrary to popular opinion, Spanish is not widely spoken by Filipinos.) The Congress passed a second law requiring instruction in Tagalog. This language is commonly used in Manila and Central Luzon. More people speak this native language than any other. However, Tagalog is required instruction now for all children in public and private schools, no matter what native dialect is spoken at home. Tagalog is now the national language.

But there are many objections on the islands away from Central Luzon and only time will tell whether the eight basic languages will be replaced by a single native language for all Filipinos.

This recent legislation adds another language to the high school student's program. Two years of Tagalog are required for high school graduation.

7. In addition to the schools supervised by the Bureau of Public Schools and those under the control of the Bureau of Private Schools, there are two instituitons that have charters from the Philippine Government. Each institution operates with its own Board of Trustees.

The Philippine Normal College was established about fifty years ago for the education of elementary teachers. This college is located in Manila, just across the street from the building used by the Philippine Congress.

The University of the Philippines in "down-town" Manila was almost completely destroyed in the battle of Manila. However, a new campus with new buildings has been established far out in the country near the city of Manila.

These two institutions and eight normal colleges supervised by the Bureau of Public Schools are sources of teachers. There are many private colleges and some universities that have programs for elementary teachers or high school teachers or both.

IV. Science in Elementary Education

What is the place of science, now, in the program of elementary education, grades one through six?

The science courses of study are prepared in the Bureau of Public Schools in Manila for all public schools of the islands. There is a science bulletin giving units of study for grade four. A related bulletin has been prepared for grade five. There is a bulletin for grade six. If there are courses of study for grades one, two, or three, the writer did not find them in use in any schools visited. However, before World War II, there must have been bulletins in mimeographed form for grades two and three.

In general, it is my opinion that not much attention is given to science in grades one through six in most of the schools in the Philippines. There are many difficulties. In the first place, all school books and many teaching materials were destroyed during the Japanese occupation. Also, children are doing their school work in a foreign language, English. It has not been possible to provide enough science courses of study for every teacher. There are very few science texts or references. The classes are large, often fifty pupils or more. While English is the language of the classroom, the native dialect is spoken at home. Most of the teachers have had only two years of college education and have no special training to teach elementary science. There are very few "in service" courses of college grade available for teachers who wish to

[1] Chester Bowles, *New York Times Magazine,* April 3, 1955. pp. 13, 63–67.

prepare themselves to deal with science activities in elementary grades.

The environment of the Filipino child is strictly tropical. The plant world is that of the tropics. The animal world is all very different from that of the temperate zones. The elementary curriculum, until recently was that of the United States and the North Temperate Zone with very few major adaptations to the lives of Filipino boys and girls. In the past years, teachers have had little or no freedom to depart from Bureau regulations. Even though there is a course of study for the upper grades, teachers hesitate to take time for science lessons. In many schools there is a fixed time schedule of classes that is honored by many years of service. Under these circumstances, science activities for fifty children working in a foreign language are next to impossible.

It may be a surprise to teachers in the United States to learn that Filipino teachers use the metric system and have little if any responsibility for the English system of weights and measures. The metric system is part of the entire course in arithmetic.

The cost of books published in the United States and sent to the Philippines is such that it is quite impossible to provide school science books in quantity for elementary grades. In general, the bookstore prices of American texts as purchased in Manila are at least twice the list prices in the United States. In cities away from Manila, the prices are higher.

There are books published by private firms in Manila and elsewhere, but the prices of these locally produced texts are still too high for most schools and most teachers.

The production of new science texts and references for schools in a tropical nation such as the Philippines will remain one of the major educational problems to be solved for some years to come.

The elementary science texts written by American authors made a great hit with the Filipino teachers. Never-the-less, these texts are, in my opinion, useful only as samples of how one nation in a temperate zone environment, with a particular culture, produced teaching materials for elementary science. In the long course of events the Filipino teachers and scientists and the publishers will have to produce a new series of school books that will serve the needs of children and the nation.

Many citizens, school officials, and teachers recognize the important place that science must hold in the future elementary curriculum in the Philippines. Serious and sustained work is in progress in several areas to develop new science units and activities that seem appropriate for a particular community. In the discussion of teacher education later more will be said on this aspect of primary and intermediate education.

V. SCIENCE IN THE PHILIPPINE HIGH SCHOOLS

Students enter the high schools in the seventh school year. However, as mentioned before, in the near future, it is expected that boys and girls will spend seven years in the elementary schools.

A very common pattern for the secondary-school science program is as follows:

Seventh School Year: General science (This subject is usually required of all students.)

Eighth School Year: No required or elective science subject.

Ninth School Year: General biology (This course is usually required of all.)

Tenth School Year: Physics (This course is usually elective. However, some schools require the course for boys and girls.)

It was quite a surprise to discover that no chemistry appears in the four-year high school program.

Some of the fundamental problems of the nation deal with:

1. A greatly increased supply of foods.
2. Improved and greatly expanded sources of pure water for domestic uses.
3. Establishment of health services with a program of youth and adult education to make these services effective.
4. The development of extensive but relatively

unused mineral resources. These natural resources include iron, silver, gold, copper ore, manganese ore, zinc, and lead. Some petroleum formations are found in these islands, also. During the year 1952, coal was mined to the extent of about 140,000 tons.

The omission of chemistry from the high school program has, at least, two very undesirable consequences: first, there is no understanding among citizens, generally, of the most elementary facts and principles of this important science as applied to the four areas mentioned above. For example, it is very difficult to deal with farmers on a problem such as the proper use of fertilizers in increasing the yield of the rice fields. Second, the problems of college education in chemistry are made more difficult for students and instructors because of the limited high-school education in science. Many boys and girls have had only general science in grade seven and biology in grade nine when they enter college. The first course in chemistry for potential physicians, nurses, engineers, chemists, and agricultural specialists has to be delayed until students reach college.

Many men and women, competent to do a satisfactory grade of college work, are probably lost for service in the scientific professions because there has been no opportunity in high school to become acquainted with the great world of chemistry and its many and varied contributions to improved standards of living.

In dealing with these problems of the place of science in the curriculum it is necessary, now, to review briefly the language situation in Philippine high schools.

As stated above, the language of instruction in subjects except Spanish and Tagalog is English. The texts, references, and other teaching aids are printed in English.

A high school student has a four-year course in English and American literature. There are many, many compositions to be written in English. But in addition to the four units of English there are, at least, two units of Spanish required by law for a high school diploma. To these six units of languages must be added two more in the national language, Tagalog, which is required by law, also. Eight units, then, must be set aside in the secondary school curriculum for these three languages. For students in Manila and nearby Central Luzon, this may not be too difficult because the two units of Tagalog are the native language. But for students in all other parts of the nation, Tagalog is a foreign language, so to speak, since there are seven other basic languages and more than 80 dialects in the several hundred islands where there are boys and girls to be educated. Outside of Manila and Central Luzon, a high school student has three foreign languages during the school program and speaks a fourth language at home and outside of school classrooms.

In the new four-year program for the college education of elementary teachers, this language problem becomes even more difficult. We will return to this subject later.

The languages that have evolved over the centuries in the Philippines; in Indonesia; in Southeast Asia; and in India demand some heroic research on the part of Unesco and the nations of the world if there is ever to be any effective science instruction to deal with problems of improved standards of living in these and other nations.

We may now return to the review of the high school courses in general science, biology, and physics.

The first regular, day-by-day instruction in science for most boys and girls in the Philippines begins on entrance to the secondary school in the seventh school year. Most schools devote one period each day to this subject. The length of the period varies and is sometimes as long as fifty or fifty-five minutes.

Since the Japanese military occupation resulted in the destruction of all scientific publications and apparatus this general science course, as well as the courses in biology

and physics must be, for most schools, a textbook course with no laboratory experiences and few, if any, demonstrations by the teacher. One of the most needed courses for science teachers in service in public and private schools is a course on how to improvise demonstrations and make simple pieces of scientific apparatus. The cost of imported equipment, at present, is prohibitive for most schools.

The general science classes are large, often 50 students or more, and a teacher may meet as many as six classes each day of the school week. Then there are many extra school duties on Saturday,—too many it seemed to the writer. In Manila and other cities it was impossible to schedule graduate classes on Saturday morning and have many teachers from the public schools in attendance.

In most schools as the writer observed them, there were very few books in the hands of students. In some classrooms there was only one textbook or a mimeographed course outline available for the teacher.

The general science course was, essentially, one of Caldwell's courses as revised and modified by one of the Filipino science teachers. A few of the units in this text seemed to be appropriate for a tropical environment. Many of the units had little or no real significance for Filipino boys and girls in the seventh school year and especially for students living in small towns, villages, and farming communities where life is very different from the activities of a temperate zone environment in the United States. The copyright date on the books that the writer examined was 1934.

The biology course was based largely on one of Hunter's books which had a copyright date the same as for the general science text just given. With the exception of the physiology and health sections of the biology course, the selection of units seemed rather unrelated to the plant and animal biology of the tropics or the problems of personal and community life. In this science course, as in the general science course, it appeared to the writer that entirely new units of instruction were needed to serve the needs of young people living in the tropics.

There was very little laboratory work in biology. While microscopes are practically prohibitive in cost, there were many opportunities for the study of local plants and animals that were not used.

The physics course that the writer found in schools was chiefly that of one of the older texts by Black and Davis. This course is for high school seniors in the Philippines and the boys and girls who enroll for this subject are now in their tenth school year. In recent years, physics has become an elective subject in many, if not in most schools. It would be interesting to know just how many boys and girls study physics in public and private high schools. However, there are schools that require credit in this subject for a high school diploma. The writer visited three high schools for girls in which physics was a required credit for graduation.

The great scarcity of physics apparatus, tools, and glassware made the teaching of physics very difficult and in many schools quite ineffective. Under the circumstances, students were forced to rely on memorization to pass examinations. At present costs for imported apparatus, glassware, tools, and materials, it will be many years before the public high schools will be able to accumulate enough equipment to give a representative list of physics demonstrations for a one-year course. Laboratory experiences, for the large classes, on a group or individual basis are something to dream about and plan for the distant future.

For the present, then, the physics teacher in the Philippines will give brief lectures and students will take notes. There are very few physics texts, old or new, for students to use. New books are highly prized but publications of any kind are very expensive and beyond the means of most teachers and students.

In this connection, there is really very great need for basic curriculum research to determine what a new physics course should be for public and private high schools. The need for a new course for the girls who study physics is very urgent, indeed.

Teachers in the United States will appreciate the difficulties that might arise in dealing with the Black and Davis type of physics course, in a foreign language, with classes in the tenth school year rather than with classes in the eleventh or twelfth school years as found in American schools.

In the field of educational measurements, there were no standardized tests or scales of Filipino authorship available to science teachers. In fact, there were practically no standardized tests available in any subject for the classroom teacher. The writer spent a great amount of time and some money in encouraging science teachers to get started in this important work. Many investigations that are needed on various aspects of science education can not be started until these new instruments are created and standardized for general use.

VI. THE EDUCATION OF TEACHERS IN SCIENCE

Most of the teachers now at work in elementary schools have had, perhaps, two years of college training. In addition to the Philippine Normal College and the University of the Philippines there are eight normal colleges in various islands of the nation where courses for teachers are conducted. Several private colleges and universities offer the four-year program for the education of elementary teachers. Some of these institutions have courses in botany, zoology, chemistry, physics, and other sciences for the training of high school teachers.

The entire pattern of the curriculum for teachers in elementary education is now in the process of a major revision and expansion. All teachers in the future will be required to have four years of college education.

This new four-year program, as you may surmise, is the subject of much experimentation, discussion, and argument among Filipino educators. For this discussion, the writer must limit the scope of this article to just two questions: (1) What is the place of science in the new four-year undergraduate program for elementary education? (2) What is the place of language study in the program for prospective teachers for grade one through six, or grades one through seven as the future may determine?

We may now consider the first question. This new four-year curriculum has two required science courses of one semester each and very few, if any, elective science courses. There was no provision for any course on the teaching of elementary science.

The required course in physical science was a one-semester course and was devoted to a brief survey of the physical sciences. The second required course was a survey of biological science and this was a course covering just one-semester in the junior year.

In this connection it is important to keep in mind the fact that a freshman in a college in the Philippines is two years younger than a college freshman in the United States.

Thus, it appears that a graduate of the new four-year curriculum in elementary education will have one year of college science prior to student teaching and later employment in public or private schools.

Now, let us consider briefly the language situation. This new elementary curriculum for undergraduates had the following requirements in the languages:

1. A student must have credit for 24 semester hours in English.
2. Before graduation, the student must complete 12 semester hours in Spanish.
3. There is a requirement of not less than 11 semester hours of the national language, Tagalog, before the undergraduate degree may be granted.

These three language requirements, then, total 47 semester hours in the four-year

program for elementary teachers. Young teachers who do not speak Tagalog as the native language, will speak a fourth language at home. This all adds up to many languages and difficult curriculum problems of the greatest possible significance!

It is the writer's conclusion, based upon nearly two years of work with many teachers, several colleges, and three universities that the very minimum time requirement for science in the new four-year elementary school program for undergraduates is:

1. A course of one college year in general biology, and
2. A course in the physical sciences covering one college year.

Both of these courses should be major laboratory courses which meet five days each week for one full college year. But these courses must be new in many respects and designed for service in a tropical environment.

There is an additional professional requirement of very great importance. This new program has a heavy requirement in student teaching. The success of these young teachers (they are two years younger, as a rule, than student teachers in the United States) will be greatly aided by a one-semester course on the teaching of elementary science. Colleges which do not have a large demonstration school for student observation and participation over the four-year program should be required to give such a course on how to teach elementary science in grades one through six or seven. Many teachers in service would welcome the opportunity to devote one or more long vacations (April and May) to such a course if given by the Philippine Normal College or other institution specializing in the summer session courses for experienced teachers.

The two required science courses now under discussion are really new courses that will have to be created and otherwise developed over a period of years by Filipinos for the schools of the Philippines. Some help can be obtained from Unesco or from courses that have been developed in the United States or other countries. But these new courses are the primary responsibility of the scientists, the teaching scientists, physicians, nurses, engineers, and agricultural specialists working in these tropical islands. National committees should be established to consider what young teachers need to learn to serve the boys and girls and the nation as a whole in these important divisions of science.

If reasons must be given for these recommendations, two may be mentioned.

1. The rapidly expanding philosophy of the community school in the Philippines makes it imperative that the teachers of the future have a better scientific education so as to provide leadership in matters of health, agricultural production, improvement of water supply, and improved standards of living in homes and communities.

2. The Russian boy (we are uncertain about the education of the Russian girl) is now spending about forty per cent of his time in school in the subjects of science and mathematics. It is time the free nations of the world gave some serious attention to these matters of Russian scientific education.

THE DEVELOPMENT OF A PROGRAM OF SCIENCE EDUCATION IN THAILAND *

Elwood D. Heiss

New Haven State Teachers College, New Haven, Connecticut

An inspiring saga is unfolding in Southeast Asia—the story of man's struggle against ignorance, poverty and disease. It is a hard and slowly advancing struggle in which the United Nations and its specialized agencies are joining with the governments and the people.

This paper deals with one phase of this dynamic struggle—the efforts of the writer and Dr. Ellsworth S. Obourn to upgrade and modernize the science education program of the undeveloped country of Thailand.

An American educator working in a foreign country generally finds himself working within a framework that is new to him mainly because the political, economic, social and educational status of the foreign country is considerably different from that of the United States. Therefore, it seems desirable, first of all, to consider the conditions within the country of Thailand under which we had to work.

POLITICAL STATUS OF THAILAND

Thailand is said to be a constitutional monarchy. In actual practice, like most Asiatic countries, Thailand is an oligarchy; that is political power is vested in the hands of a few. There is no strong opposition party to those in power. At present the actual governing body consists of a coalition of generals of the army, admirals of the navy and high officers of the state police.

Now this great centralization of political power has a decided effect on the educational system. The educational system is highly centralized. The ministry of education exercises complete control over school finance, curricula, courses of study, textbooks, school buildings, and teacher certification. There are no local boards of education. There is just one system of education, controlled and regulated by the Ministry of Education in Bangkok.

How does all this affect a foreign educator? It can be an advantage to him. If he can sell an educational idea or policy to the Ministry of Education, it can be put into effect immediately throughout the nation. Of course the converse is also true.

ECONOMIC STATUS

Some Americans think of all of Asia as being composed of a horde of poor, illiterate, starving people. This may stem from what they have heard or read about India and China. We do not know too much about China at present but in India undoubtedly economic and social conditions are very bad.

But conditions are somewhat different in Southeast Asia. The countries of Southeast Asia are under populated. This is true of Burma, Indo China, Malaya and Thailand. Experts of the Food and Agricultural Organization of the United Nations have estimated that Thailand could support four times its present population if the country were properly developed. Thailand has an abundance of food and it exports over a million and a quarter tons of rice each year. People in Thailand have plenty to eat. However, the prevalence of malnutrition and food deficiency diseases indicates that most Thai people have yet to learn the importance of a balanced diet.

Thailand has an agrarian economy. And there is no mechanization of agriculture.

* Based on observations while in Thailand (Siam), April 1952–May, 1953 under the auspices of UNESCO. The author served as consultant and adviser to the Ministry of Education.

Farming operations are about the same today as they have been for centuries. They are based upon the use of the water buffalo and human labor. There is no industrialization. Things that are made are done so through a unique system of home crafts.

THE EDUCATIONAL SYSTEM

Thailand is divided into seventy-one *changwads* (provinces), with a governor at the head of each. The schools in each *changwad* are administered by an educational leader called the Education Officer. He is appointed by the Minister of Education.

The public school system is organized on a 4–6–2 plan, as follows:

Four elementary grades, called the Pratom schools;
Six secondary school grades, called the Matayom school;
Two pre-university grades.

In addition there are a few so-called infant schools of the kindergarten type and some vocational schools.

Out of a school population of about 3 million only about 100,000 pupils are in the secondary schools. This means that for most children their education will consist of four years in the elementary school. The Ministry of Education is now working on a new type terminal school which would give all pupils seven years of schooling. They realize that four years of schooling is not enough. Illiteracy is estimated to be about 50 per cent for people above thirteen years of age. Illiteracy is higher among women than men.

INSTRUCTIONAL MATERIALS AND CLASSROOM TEACHING

Instructional materials are quite limited. Thai children do not have well bound, beautifully illustrated textbooks like the ones American school children use. There are no free textbooks. Since families are large and many people are poor, many children never have books. Rarely does one see maps, globes, charts, pictures and the other sensory aids so widely used in American schools.

Throughout the school system most of the teaching is done by the lecture method. One rarely ever sees animated class discussions, or signs of initiative and creativeness on the part of the pupils.

Each pupil has a notebook and a pencil. The teacher either tells the children the information or writes it on the blackboard. The pupils write it in their notebooks, try to memorize it, and recite it to the teacher later. The chief goal of learning is to clear the examination hurdle which bars entrance to the next grade.

THE PILOT PROJECT

Much of our work was centered in a pilot project in a rural provincial area. The province of Cha Choeng Sao, about sixty miles from Bangkok, was designated by the Ministry of Education as the area for experimentation. This province is a primitive, yet a typical educational environment. It possesses agricultural lands, river districts and forests. The provincial capital, also called Cha Choeng Sao, has a variety of schools: kindergarten, pratom, matayom, vocational and a teacher training college. Ten pratom schools, a boys secondary school, a girls secondary school, a vocational school and the girls teacher training college were used as centers for experimentation.

We found a very barren condition in the teacher training college. Physics, chemistry and biology were being taught with no laboratory, no demonstration room, no apparatus, and no textbooks. Science was taught as a series of lectures with the students taking notes.

Plans were drawn for a laboratory and a science demonstration room. Using the facilities of the vocational school a laboratory for 40 students with work tables and storage cabinets and a classroom with a demonstration desk were provided at minimum expense.

In addition, Unesco and the Mutual Security Agency of the United States have given about $8,000 worth of scientific apparatus and supplies to this college. This

school is now well equipped for individual and group laboratory work and also for teacher and student demonstration work.

The completion of the laboratory made it possible to give new directions to the teaching of science. For one thing, it was now possible to introduce problem solving and the inductive method of teaching science. It should be interesting to American science teachers to note here that the inductive method was an entirely new concept to Thai science teachers. Many conferences were held and much guidance was given in order to get these teachers to try this kind of science teaching.

The new science laboratory was also used as an in-service science education workshop. Teachers from the elementary and secondary schools and also the headmasters of these schools would be transported periodically to the teacher training college for in-service training. Here they would be taught other techniques of science teaching than the lecture method, how to use the ordinary classroom for science teaching, how to make simple equipment, and how to use the resources of the local community in teaching science.

We also worked directly with the ten elementary schools and the two secondary schools in the pilot project. Because of the language barrier much of the guidance and supervision had to be done with the assistance of our Thai counterpart who could speak English as well as Thai. Gradually science lessons and the materials and equipment needed in these lessons were developed. Such teaching and motivating devices as aquaria, terraria, science tables, a weather station, a bird feeding station, and some simple equipment are now standard equipment in the schools of the pilot project.

We began the development of a program in science for these schools based upon the philosophy that for children their study of science should be centered around a study of their environment. Several science units (each one being built around a phase of the environment) were written and translated into Thai language as models for experimentation.

The pilot project is planned for a period of ten years. During the first five years, the Ministry of Education with the help of foreign educators will be working to make the schools in the pilot project model schools. During the second five years it is hoped that the new methods of teaching and the new instructional materials will be applied in other provinces of the country. However, already the experimental work at Cha Choeng Sao is having its effect. Nearly every week a group of teachers from some province in Thailand visits the pilot project to observe the changes being made in the schools.

TEACHER TRAINING COLLEGES

The big educational bottleneck in Thailand lies in the field of teacher training. Seven out of eight elementary school teachers are now without an adequate preparation for teaching. Yet it is in the elementary school where nine out of every ten teachers are likely to be employed. It has been estimated that for Thailand to correct the present inadequacies in its teaching force, to take care of the rapid turnover of teachers, and to provide for the demands due to an increasing enrollment, at least 10,000 new teachers should be graduated each year from its teaching training institutions.

There are thirty-two teacher training colleges in Thailand. Six of them are in Bangkok; the remaining twenty-six, called provincial teacher training colleges, are scattered over the kingdom. The combined enrollment in all these institutions is about 4,000 students. Obviously, under present conditions the supply of teachers will never catch up with the demand.

IMPROVEMENT OF SCIENCE TEACHING IN THE TEACHER TRAINING COLLEGES

The provincial teacher training colleges had no science laboratories. Several of the

colleges in Bangkok had a laboratory but very little apparatus and supplies. For the most part the students' education in science consisted of listening to lectures. It became rather clear that to improve science teaching in the teacher training colleges, laboratories, scientific apparatus and laboratory guides were needed.

A blueprint for a general science laboratory was made. A print was sent to all the provincial teacher training colleges with the understanding that if they built a laboratory, they would receive a certain amount of apparatus and supplies from UNESCO and M.S.A.

A workshop was organized at Suan Sanantha College in Bangkok. For nine months, one afternoon a week, I met with fifteen science teachers from the six teacher training colleges in Bangkok. The chief outcome of this workshop was the writing of a science laboratory manual (in Thai) which contains 140 experiments covering areas of chemistry, physics and biology. Through this project several goals were attained.

1. It gave a group of Thai science teachers valuable experience in the techniques employed in textbook writing.
2. A laboratory manual of good quality is now available to all the teacher training colleges.

Several hundred copies of this manual were reproduced. Each teacher training college in Thailand received a minimum of six copies. With each college having a laboratory, scientific apparatus and a laboratory manual a more effective program in science education became possible.

OTHER ACTIVITIES

It should be evident at this point that our major efforts were directed toward projects that would eventually influence science teaching nationwide. Of course we were confronted with other problems and projects but they were too numerous and diverse to be described in any detail here.

Some work with the Science Society of Thailand resulted in some fruitful developments. The work of this organization had been devoted almost entirely to pure science. Through our efforts the Science Society organized a section for science teachers which has proven to be very popular. Also the organization is now devoting a section of their monthly magazine to science teaching.

The Science Society also has a four day annual meeting. Science exhibits from students in the elementary school through the University are exhibited. Many of the exhibits are operated and explained by the students. It could be called a National Science Fair. It was one of the most inspiring experiences the writer has ever had in a long career in science education.

The writer has come to several conclusions on the basis of his experiences in Thailand. He is offering them here with the hope that they may be helpful to other science educators planning to work in a foreign country:

1. One should enter a foreign country with an open mind. If you go into a foreign country with many preconceived ideas and a fixed program in mind, you are bound to find yourself, sooner or later, in a state of disillusionment. Things are never the way you expect to find them.

2. One must be content to work within a certain framework fixed by the traditions and practices prevailing in the foreign country. This framework is delineated by the political, economic, social, and educational status of the nation.

3. One should not attempt to or expect to be able to transplant *in toto* our program of science education to a foreign country. Our program of science education was not developed in a year or a decade. Rather one should study what they have, accept what they have and then help them to grow. All one can do is help them to evolve and to some extent accelerate this evolution.

SCIENCE EDUCATION IN LIBYAN SECONDARY SCHOOLS *

Vernon C. Lingren
University of Pittsburgh, Pittsburgh, Pennsylvania

The young nation of Libya is situated on the Mediterranean Sea with Tunisia on the west and Egypt as its neighbor on the east. The Egyptian secondary-school curriculum has been decreed by the King of Libya to be the official program in the schools of this country, and so a real Libyan system of education has not been established. The underdeveloped nature of this country extends to all education, although outside agencies such as the United Nations and the United States Mission to Libya (formerly Point IV) operating under the International Cooperation Administration, are lending assistance which is designed to improve educational conditions as rapidly as possible.

In the regular Libyan secondary schools the Egyptian curriculum is followed very closely with minor alterations such as an increase in the number of periods per week devoted to a given branch of science. In the teacher training and technical schools, in which the work of the outside agencies is more pronounced, considerable modification is being recommended in order to *adapt* the curriculum to Libya rather than to merely *adopt* it as was done originally. The acceptance of such modification is slow. One factor to be considered is the presence of Egyptain Educational Missions in Libya, including advisors who work closely with the local Departments of Education in the provinces and with the Ministry of Education at the Federal level. Progress is being made, and a desire for a more appropriate program of science teaching is being created.

The Libyan secondary-school pupil enrolls for his first year of work following completion of a basic education in elementary and primary schools which covers a total of six years. The beginning secondary pupil is thus comparable to the American junior high school child with reference to educational level. In considering the sequence and grade placement of courses, as indicated in this article, this is an important fact to remember.

The following description of a "typical science program in a Libyan secondary school" was prepared with the assistance of an Egyptian science teacher who had originally been sent to Libya as a part of the Egyptian Educational Mission to that country. It is believed that the information is accurate and representative of actual practice in the country.

Science is required during each of the secondary-school years. General science is scheduled for four periods a week during the first year and for three periods weekly the second year. Laboratory instruction is stipulated as the activity during one of these periods throughout the two years. In both the third and fourth years physics is required while chemistry is included in the third year and replaced by biology in the fourth year. Physics instruction is initiated with a three period per week time allotment in the third year which is reduced to two periods a week in the following year. Chemistry and biology receive three periods per week in the third and fourth years respectively. Laboratory instruction in one double laboratory period per week is the usual practice, and in some schools an extra period has been added to the physics time table in the fourth year to make this possible. A Libyan secondary-school pupil may continue for a special fifth year of instruction, including rather extensive work in science, if his school has the proper staff and equipment. The curricu-

* Based on observations made as Educational Advisor, Teacher Education under the Foreign Operations Administration, United States Mission to Libya.

lum of this fifth year is not included here as it is not a part of a "typical program" at present, and is so new to Libya that adequate information on its content is not available. Until recently fifth year students were sent to Egypt due to lack of proper facilities in Libya.

The nature of the instruction in three of the four science courses may be indicated by the partial topical lists which follow. They are believed to be representative of the content taught in the majority of science classes in Libya although they were submitted by one individual science teacher. It is to be remembered that these topics do not constitute a full course of study, but are selected to give an overall view of the general type of material included in the courses.

GENERAL SCIENCE I

Water—natural resources and characteristics
Animal life in fresh and salt water
Use of water by humans
Plant life in water
Evaporation and condensation
Filtration, distillation, crystallization, and sublimation
Heat—expansion and contraction of solids and liquids
Thermometers—boiling and freezing points
Phases of matter
Volume of solids and liquids
Density of solids and liquids
Levers—kinds and examples
Water power from waterfalls
Water vapor and its use in machines

GENERAL SCIENCE II

Air and air pressure
Charles' Law
Boyle's Law
Movement of bodies in the air—balloons and airplanes
Effect of heat on air
Convection, conduction, and radiation
Effect of air on metals, rust
Oxygen—formation and preparation—physical and chemical properties—preparation of oxides
Acids, alkalies, and salts
Mixtures and compounds
Gaseous, liquid, and solid fuels
Combustion—quantity of heat and calculation of specific heat
Air and life—respiration and photosynthesis
Microbes and bacteria
Foods and vitamins

CHEMISTRY

Solubility and crystallization
Distillation, filtration, evaporation, and sublimation
Mixtures and compounds
Chemical and physical changes
Acids, salts, and alkalies—titration
Oxygen—preparation, properties, and uses
Hydrogen—preparation, properties, and uses
Water—composition and properties
Nitrogen—preparation, properties, and uses
Sulphur—allotropic forms and modifications
Compounds of sulphur—composition and uses
Uses of salts of phosphorous, sodium, and potassium
Chlorine—preparation, properties, and uses
Carbon and its compounds
Brief account of sugars, starches, and fats

PHYSICS I

Light
Sources and transmission
Light rays
Formation of images
Shadows including an eclipse
Reflection of light including images formed by various mirrors
Laws of Reflection
Refraction of light including a study of prisms
Laws of Refraction
Lenses including study of images
Optical instruments including simple and compound microscopes, film projectors, telescopes, and cameras
Spectrum analysis

Sound
Kinds of sound
Transmission of sound in gases, liquids, and solids
Velocity of sound including calculations
Reflection of sound waves including laws
Resonance including laws
Musical instruments

PHYSICS II

Magnetism
Properties and different kinds of magnets
Magnetic Laws
Magnetic and non-magnetic materials
Magnetic effects including magnetic fields and lines of force
Magnetic compass

Electricity
Static electricity
Conductors
Electroscopes
Electrical effects
Laws of Static Electricity

It has been recommended to one of the international agencies operating in Libya that a survey of science education should be conducted in this country. Such a survey should include an evaluation of the manner in which the Egyptian curriculum

is being used in the secondary schools and point the way for progress in future adaptations to the unique Libyan conditions and needs.

If the partial topical lists cited here are truly representative of practice in Libya many modifications might well be suggested as the result of such a survey. The grade placement of the various courses as reported here should also be examined if progress is to be achieved.

It would be presumptuous and unscientific to formulate definite evaluations on the basis of the limited material presented here. As indicated previously, this preliminary view of science education in Libyan secondary schools is based on limited data. However, the need for a comprehensive survey is indicated by these data, and it is hoped that it will be forthcoming so that action may be taken to the end that Libyan youth may be more adequately prepared to meet the urgent life adjustment problems which are so numerous in this country.

EDUCATION IN LIBERIA * †

Marvin David Solomon

Michigan State University, East Lansing, Michigan

In November of 1952 I accepted an assignment with the UNESCO Technical Assistance Mission to Liberia. I proceeded to my duty station, via Paris for briefing at UNESCO Headquarters, during March 1953. My family and myself remained in Liberia till March of 1954.

The following excerpts from my briefing instructions will best describe my duties:

> In the field of Chemistry and Biology, "to develop a program of teacher training and to advise the Government on all problems connected with the training of secondary school teachers. . . .
>
> As a general guidance for your personal work in Liberia, the following two points should be kept in mind:
>
> "a) that any work projected or undertaken should bear a direct relation to the economic development of Liberia; and
>
> "b) that any such project should be assured of development and successful conclusion by local experts after the departure of the international team."

The UNESCO Technical Assistance Mission to Liberia was engaged in three primary spheres of activity: (1) formation of a science program in the University of Liberia, (2) formation of a program of secondary science teacher training, and (3) the formation of a fundamental education program. The program was known as the "Joint UNESCO and Liberian Educational Project"—commonly called "JULEP." The mission was quite cosmopolitan in its personnel, there being representatives of Norway, England, Denmark, France, Belgium, Holland, Austria, Haiti, India, and myself from the United States. This international flavor was certainly one of the very fine features of working on this sort of a project. I might venture an opinion here and say that on the basis of this group of people, I find the American educator to be somewhat less conservative than the European educator.

THE SETTING OF THE COUNTRY

As can be seen from my briefing instructions, one of the major points of the Mission is an attempt to set up the instructional machinery that could be used to train the people of Liberia in the sciences and in

* Contribution number 72 from the Department of Natural Science, Michigan State College.

† The author was in Liberia during 1953–54 and 1955–56 under the auspices of UNESCO. He acted as advisor to the Republic of Liberia on all questions dealing with science education specifically and teacher education in general. During 1956, the author became Chief of the Mission and as such worked not only as specialist in science education, but also had charge of the fundamental education program.

the technical skills, and through this to eventually better the economic standards of the country. In order to better understand the problem a brief description of the country is necessary. I shall be quoting quite liberally from the report of the UNESCO exploratory mission to Liberia.

Liberia is a small country of some 43,000 square miles—about the size of Ohio. There are various estimates of the population. On the basis of a number of reports I would estimate around one and a half million people. The country is located on the West coast of Africa just north of the equator. The climate is mild and very humid. The rainy season extends from about May to October, the rest of the year is characterized by hot, dry winds from the Sahara. We found the climate to be not at all uncomfortable.

The basic economy of most of the people is subsistence agriculture. The vast bulk of the population depending on farming of the shifting fields type. In this type of farming a field is roughly cleared and a crop of cassava or rice is planted. After one crop the field must lie fallow for several years. Other crops, minor ones, are: palm nuts, coffee, pineapple, peanuts, cocoa. Because of the tsetse fly there is no live stock. There is a shortage of protein foods. One might consider rubber as part of the agricultural pattern. The Firestone Plantation Company has a vast rubber concession in Liberia, about 30,000 workers and their families live on the plantation. There are a number of Liberians with small plantations who are aided, to a degree, by the Firestone people in developing these holdings.

Several major developments have taken place in recent years. The first of these is the building, with American capital, of the free port of Monrovia. This has made possible the relatively easy landing of heavy equipment. Hehetofore all materials had to be landed by surf boats. The second development of consequence has been the opening of the iron mine at Bomi Hills. Some of the richest ore in the world comes from this mountain of iron. There has also been the construction of a railroad to bring the ore from the mines to the port. This is the only railroad in the country, and it has been developed, at the present, only as an ore carrier.

The basic resource of the country is the people. Traditionally the people of Liberia can be divided into two main groups: the aborigines and the Americo-Liberian ruling class. These latter people are descendants of founding immigrants from the United States in the nineteenth century. The aboriginal peoples are composed of some eighteen tribal groups, speaking twenty-six different dialects. The Liberian Government was founded by the immigrant groups and is still largely made up of them. However, a number of men from tribal backgrounds now hold important positions in the government and President Tubman is making constructive efforts to overcome old social distinctions between "civilized" and "uncivilized" people. His policy is that "we are all Liberians." English is the official language of the country, although five per cent or less of the population is literate in English. There are a great many Mohammedans in Liberia, especially among the Mandingo people, some of whom can read and write Arabic. Of the tribal peoples only one tribe, the Vai, has an alphabet.

EDUCATIONAL SYSTEMS

It is within this setting that the educational system must be understood. The laws of Liberia are quite explicit in demanding universal education. However, the implementation of these laws is quite a problem. Government elementary schools exist in only a portion of the villages, located mainly in the coastal area. The efficiency of these schools is extremely doubtful. In addition to the Government school system there is a series of mission schools maintained by mission funds. In general these schools are operating on a higher level than the Government schools in terms of

equipment, training of teachers and academic standards. It should be noted that the government is in some instances aiding in running the mission schools by contributing funds for buildings and equipment.

There are two other school systems in Liberia that must be taken into account: the Poro schools and the Mohammedan schools. Much of the life of the native is governed by the secret societies of which the Poro society is foremost. Long before the advent of the Republic of Liberia the Poro Society conducted its 'bush' schools; schools that trained the youth of the tribe to take their place in the existing society. They are still in force in the Liberian hinterland. The Mohammedans have a regular system of education whereby individual teachers teach individual disciplines. These two school systems play a considerable role in the education of the native youth and must be considered in any planning of the overall educational system of the nation.

There are a number of institutions of higher learning in Liberia. The chief of these is the University of Liberia. The University is organized on the same basis as an American University. Other institutions of higher learning include Cuttington College of the Episcopal Mission and the teacher training school, Maryland College Of Our Lady of Fatima of the Catholic Mission. At the high school level there are a number of schools maintained by the Catholic, Methodist and Episcopal missions. The Booker Washington Institute, dealing largely in vocational education has been, up to last year, supported jointly by the Phelps-Stokes foundation and the Liberian government, but is now under the control of the University of Liberia.

The Government of Liberia, through the Department of Public Instruction has been striving to increase the efficiency of the educational system. One method of accomplishing this has been the awarding of government grants and scholarships. In 1953, out of a total budget for the Department of Public Instruction of one million dollars, five hundred thousand dollars was earmarked for study abroad in the areas of nursing, medicine, education, business administration, dietetics and home economics, civil engineering, mining engineering, veterinary medicine, economics, etc.

PROBLEMS IN EDUCATION

The problems that appear on the Liberian educational scene seem almost insurmountable. It is lamentable that all programs designed to aid Liberia are seemingly on a short term basis. Such programs as those developed by the UNESCO Technical Assistance Program and the United States Point Four Program are all laudable, but unless they are planned on a long range basis they are doomed to failure. By long range I mean that the programs planned should encompass periods of time of at least ten to twenty-five years. There have been many foreign advisors on short term contracts in Liberia—economic, financial, agricultural and educational—in the past. In general their results appear to be almost nothing. One of the primary reasons for this is that the solutions to problems have been given in large and rather undigestable chunks which are promptly spewed forth upon the departure of the foreign expert. The problems facing Liberian education are, in reality, not unique to Liberia. We have the same problems in our own educational scheme, but to a lesser degree.

The basic problem of Liberian education centers about the elementary system. The problem can be summed up in a few words. Upon being tested it was found that, of the eleven hundred elementary school teachers of Liberia, 85 per cent had achieved the academic level expected of an American sixth grade child or lower. Of these 85 per cent, 75 per cent had reached to the fourth grade or lower. This is not the fault of the teacher. The Liberian teacher is as capable of attaining the same degree of learning as his American counterpart, if given the same training. The low

level of achievement indicated by the Liberian teacher is a reflection, not of a poor mentality, but of extremely bad training. It was suggested that a long range program of upgrading the elementary teacher be placed in effect. Primarily, this would consist of taking from the school system, the first year, one hundred of the best teachers and putting them through an intensive one year training program to up-grade them to about the first year of high school. The second year to do the same with a second one hundred. Of course as one dipped into the lower echelons the training time would have to be increased. Parallel to this program would be a greatly intensified teacher training program in the University. The Government of Liberia has also instituted an improved salary schedule. It is interesting to note that the possessor of a B.S. in Education receives a higher salary than the possessor of a B.A. The American Point Four educational advisor, Dr. Edward Brice, has been instrumental in providing an instructional syllabus for the teachers in the field. In terms of instruction in the methodology of teaching such subject matter as arithmetic, reading, and science the syllabus is very good.

On the high school level the situation is just as deplorable. Teachers are ill trained and ill paid. Science teaching is, in spite of its being listed in the curricula, almost non-existent. Five science teachers from the Government high schools were brought to Monrovia for further training. Four of the five had practically no knowledge of any science. The fifth was fairly good in physics and mathematics. To take the place of these five, UNESCO recruited well trained and experienced foreign science teachers. Upon interviewing these foreign teachers, after they had been teaching some time, I found that science teaching in the past had, for all practical purposes, been of little or no value due to the poor basic instruction. In many cases science instruction takes place in a veritable vacuum due to the lack of a technological environment of any kind. Another factor hindering science instruction is the poor training of the students at arrival into the high schools. Reading and writing has not been adequately taught. In general, the poor learning and teaching at the high school level is a reflection of the same situation at the elementary level.

As has been stated previously a beginning has been made in teacher training at the University of Liberia. But the University itself is in desperate need of an adequate and competent teaching staff. But an even more desperate need is that of adequately prepared students. Even the finest teaching staff in the world would find it most difficult to teach, on the university level, the undergraduate student at the University of Liberia. Again it is important to state that the student at the University of Liberia is an capable as his American counterpart —provided he has the necessary educational background to receive the instruction. Much of the time of the University instructor has to be spent on the teaching of the three R's.

Science teaching is a most difficult task. It is possible to teach the facts of science, but the philosophy and methodology of science is another matter. It appears to me that the answer to this lies in the fact that the Liberian student, especially those who come from the hinterland, have had little exposure to a technological way of life. They have had little or no experience with machines, telephones, radios, and all of the thousand and one mechanical gadgets that make up the life of the American child almost from birth. From his earliest beginnings American youth is exposed on all sides to the results of pure and applied science. It is his environment. This is not so in the case of the Liberian student. The philosophical outlook of the Liberian student also differs in relation to science. In general we would accept, almost without question, the integrity of a research scientist. We might question his method and interpretation of result—but usually

not the integrity of the worker. This is fairly well accepted by the American student. However, this is not the case of the Liberian student. Upon discussion of this point, almost all of the Liberian students evinced acute surprise and scepticism that we would take the word of a researcher as to his results. When the idea of repeatability was brought in, this, too, did not convince. In a number of cases, not the majority, there appeared to be the effect of so-called "jungle science," the belief in good or bad "medicine." I also found that a number of the students and graduates of the University resorted to the jungle or 'country' doctor rather than to the doctor possessing the M.D. degree. This should not surprise us as we often encounter superstitious beliefs among our own students.

POSSIBLE SOLUTIONS

Previously a plan for upgrading the teachers in the elementary system was suggested. It was hoped, if the plan were placed in operation, that in about ten years the elementary schools would have a well trained central corps of teachers. It was further hoped that this would be reflected upward into the high school by sending to the high school well trained students. And reflected still further upward into the University. This plan, of course would have to be in conjunction with a teacher training program in the University and a program of foreign scholarships for the training of new elementary and secondary school teachers.

The program of foreign scholarships is carried on as a vast project in Liberia. Last year 50 per cent of a million dollar budget was devoted to foreign scholarships and grants. The program is carried on not only as a means of training technicians, but as a way of having Liberians see what the rest of the world is like. This last is one of the stated wishes of President Tubman. However, a few faults have developed. The most important of these faults lies in the fact that in many cases the students are not prepared to carry on a program of University work in the United States or elsewhere. None of the first students that were sent to New Zealand were able to pass the matriculation examinations after the first year. However, their teachers stated that it was of value to continue them on the program as they were a worthwhile and diligent group of people. Again it should be pointed out that the Liberian, given proper training, is as worthy as his American counterpart. I cannot stress this too strongly. Liberian students at Michigan State University, at the moment are all doing well in their various fields; a senior student in veterinary medicine, a Ph.D. candidate in soil chemistry, and an undergraduate student in forestry. It may be much cheaper in the long run for the Liberian government to hire foreign teachers for the express purpose of training prospective candidates for foreign scholarships in the basic skills in Liberia.

There are several other, perhaps minor, faults in the system of foreign scholarships. As the number of high school graduates increases it might be better if the granting of scholarships were on a competitive basis. In many cases the amount of money awarded for living is quite a bit in excess of the actual expenditures which leads to a terrific amount of waste. And one warning to ourselves. We are not doing any one a favor by being lenient to foreign students. To allow foreign students to return to their native land ill trained because we are "sorry" for them may be doing a dis-service to their native land in leading to the possible perpetuation of shallow learning. I think it would also be highly desirable for the student to enter into a phase of actual experience before returning home. In most cases they will not be able to get this experience in Liberia, but will be entering into their professions with major responsibilities and exaggerated ideas as to their own importance.

In general, I think that the Liberian

government has shown great foresight and intelligence in the program. It is certainly a courageous act to devote half of the budget to this purpose. President Tubman has taken a personal interest in seeing that the program is successful.

UNESCO has taken on the job of supplying a science faculty to the University and of instituting a science program. It has supplied a zoologist, chemist, mathematician, and physicist to the University. This team has attempted to build a science curriculum. Most success has been achieved by Professor Percy Gideon of India with the zoology sequence. The program has had to start from scratch. There was little or no equipment, lack of space, no reference books, no textbooks. The students have been described before as having had almost no experiences in the sciences and mathematics. My major criticism of the program is that it has been geared to a developed country and not an undeveloped one. At the moment it is a luxury to train a pure scientist; what is needed are applied scientists. In its present status, the country cannot utilize men who are receiving training in general chemistry, general zoology, general mathematics, general physics; but the country does need desperately, soil chemists, mining engineers, agriculturists, entomologists, and other practical scientists with the training leading to the B.S. degree.

FUNDAMENTAL EDUCATION

Possibly the most important educational program in Liberia today is that concerned with the joint UNESCO-Government Fundamental Education Program at Klay in the Western Province. This project, centering in the midst of the tribal area of the Gola people, is a vast project in terms of the square miles of territory covered by a relatively small group of men—approximately some 3,600 square miles. There is one road through the area—a dirt road that is a veritable mud hole in the rainy season. This road extends from Monrovia to the Bomi Hill Mine, and it is paralleled most of its length by the mine railroad. Upon leaving Monrovia one is almost immediately transferred to the low bush housing a primitive people. Perhaps the best way that I can describe this project is to quote excerpts from an article in the September 1, 1953 issue of the *Liberian Age* by Mr. Bai T. Moore, a Liberian who worked as the senior member of the Liberian staff for the Fundamental Education Project.

> The question is being constantly asked, "What are the F. E. doing?" referring to the JULEP Fundamental Education program in the Klay area. . . . This question can best be answered by over three hundred boys and girls who are being given an opportunity to obtain an elementary education in eleven village schools scattered over thirteen clans divided into three major tribal groups with slightly different ethnological backgrounds; by over 8,150 men, women and children who have or are receiving the benefits of modern medical care in one small clinic at Armina; by hundreds of farmers who are learning new ways to produce more food and prepare better market crops such as palm products and coffee; by scores of young and inexperienced mothers, who are learning modern methods of child care. . . . The task of preaching this gospel of self help is presently being carried on by a small team composed of two foreign specialists and a half dozen Liberian assistants. The response may appear slow when compared with standards of living of peoples who enjoy a higher level of development. . . . It must be borne in mind that primitive peoples do not abandon archaic mores overnight.
>
> Here are some concrete examples of the new transformation taking place in the lives of the villagers in the area. Dagoebili, a village, . . . applied for an F. E. school . . . they were told that if the village could provide a free home for the teacher, clear a plot for a school garden, build a large kitchen that could be used for the school house, provide a place for a shop, and have half the children in the school girls, they would get a school. . . . The men got together and started to build three miles of road to join the main road leading from the Bomi Hill road to the Loffa River, so that the members of the F. E. team could motor to their village. . . . Two new palm oil presses and nut crackers supplied by the T.C.A. were recently introduced in the area and placed in Sasstown and Dimeh. Since the machines are too bulky to carry about from village to village, several communities are now organizing efforts to improve existing trails which can be used by light vehicles to reach the machines. . . . David Sando of Mono has not waited to be placed on the payroll of F. E. teachers, he is daily teaching thirty-nine boys and girls in a large kitchen provided by the elders of Mono. . . . Mrs. Grace Davis of

Gbamgbana was approached by the people of Todime Gaya, Jawajei and Center Hill to intercede for an F. E. teacher for their children. While waiting to get the teacher, she is holding classes in her home with an enrollment of twenty-five boys and girls. . . . In order to learn a better way to care for their babies, the Clan Chief's wife in Dimeh called a meeting of the leading women in the community to raise funds for a new building where expectant mothers can be confined. The women could not wait for a new building. "Why not ask the chief for a building he is not using?" The chief consented and provided a house. Wiewolo, a village sixteen walking miles from the motor road, is ready to build its modern school. All that is holding it up is a member of the F. E. team to wade a few swollen creeks and show them how to do it. . . . The medical and health education program cannot be praised too highly. The resident nurse, who has been nicknamed 'Pini', and other female members of the team are not waiting for the women to come to a center, they visit the mothers and school children in the homes and on the farms to teach them how to keep their surroundings clean. Taboos of centuries are gradually giving way to modern medical technique. "If I did not take Mandile to the clinic she would have died," a mother remarked recently. When asked what the clinic did to her baby, "one injection drove the witch out of her." . . . It is no longer a taboo to walk proudly into the clinic to be treated for a social disease. . . .

By jeeps, rafts, canoes and foot the small F. E. team patiently goes about from village to village trying to preach the gospel of self help to a people who have been tied down by centuries of ignorance, poverty and disease.

The most important part of the Fundamental Education Program is the establishment of elementary schools. As previously stated the basic problem is concerned with the training of elementary teachers. Under the F. E. Program teacher training is a major tenet. Part of my work was to establish a teacher training program for the F. E. teachers. This was done. The teachers met with me every Friday at one of the villages located near the motor road. It was a rare occasion when a teacher did not attend; and this in spite of the fact that some of them had to walk four or five hours, one way, over jungle trails that in the rainy season were often flooded and streams so swollen that the only way across was by swimming. I cannot praise these teachers too highly—they are a dedicated group of Liberians. They are fundamental to the Fundamental Education Program.

Of all the programs being carried on in Liberia by the Government of Liberia, by the American Point Four, by the United Nations Technical Assistance, by all of the various religious missions, I am in the firm belief that the JULEP Fundamental Education Program is the most important, the most effective, and has the greatest chance of succeeding when the international team leaves. It is starting in the place where help is needed most and follows the principle of the greatest good for the greatest number.

STANLEY B. BROWN

Stanley B. Brown has accepted an interim appointment with International Cooperation Administration, Belo Horizonte, Brazil, effective June 15, 1959. Dr. Brown's responsibilities will center on the teaching of science in Brazil's elementary schools and will be on leave from the University of California. L. Barbara Brown will collaborate in the science education assignment. The Browns address: USOM, c/o American Embassy, APO 676, N. Y., N. Y.

THE TRAINING OF SCIENCE TEACHERS IN THE DEPARTMENT OF EDUCATION, MANCHESTER UNIVERSITY

Frank Gorner
Manchester University, Manchester, England

I. INTRODUCTION

The department of education, the department of education of the deaf, the department of adult education and the department of physical education constitute the Faculty of Education at Manchester University. Each year the department of education trains approximately 160 to 170 students. Of these students, some 15 to 20 are specifically trained to teach in primary schools, while the remainder train to teach in secondary schools. The majority of this remainder are Arts graduates, but between 30 and 40 are science and mathematics graduates.

Outline of School Organization

In England, children usually enter the infant department of a primary school at 5, and transfer to the junior department at 7. At 11, a selection examination is taken to determine to which type of secondary school a child shall be transferred, viz., grammar, technical or modern. In general, the 15–25 per cent of children who are most intelligent go to a grammar school or a technical school, the remainder to a modern school. The examinations are set by local education authorities and frequently consist of tests in English, Arithmetic and Intelligence, although there is considerable variety in the content and form of the examination. Again, variable emphasis is laid on junior school teachers' estimates, interviews, etc. As accommodation in the various types of school varies from one education authority to another, there is no fixed lower limit for I.Q. which would enable a child to enter a grammar school. Thus, whereas in one area an I.Q. of, say, 110 would earn a grammar school place for a child, in another area it would not.

Few secondary modern schools enter children for external examinations as these have been developed mainly for the 'academic' pupils of grammar schools. The modern school course is frequently rather less than four years in length as most pupils leave at the end of the term during which they reach the age of 15. As most grammar school pupils are only ready to sit the external examination at 15+, it will readily be seen that few modern school children can take the examination unless the school has very good facilities and can keep the children at school after they have reached the age of 15. This examination, for the General Certificate of Education (G.C.E.) marks the completion of the normal grammar school course and is normally required for entry to universities and various professions. It is also taken by an increasing number of children in secondary technical schools. After taking subjects at ordinary level in the G.C.E. examination, some children (mainly in grammar schools) stay at school until they are 18 and then take the examination at advanced and scholarship level. These examinations are organized by eight independent examining bodies which are closely associated with the universities.

Science Papers Set in the G.C.E. Examination

Ordinary Level	*Advanced Level*	*Scholarship*
Physics	Physics	As for advanced level
Chemistry	Chemistry	
Physics with Chemistry	Botany	
Biology	Zoology	
General Science	Biology	
Botany	Geology	

University Entrance Requirements

University entrance requirements are rather variable but will approximate to the

following, which are those for the Universities of Manchester, Liverpool, Leeds, Sheffield and Birmingham.

either

(a) A pass in six subjects which include:—
  (i) English Language.
  (ii) A language other than English.
  (iii) *Either* mathematics *or* an approved science.
  (iv) At least *two* subjects at the advanced level.

These requirements may be fulfilled at more than one sitting.

or

(b) A pass in five subjects which include:—
  (i) English Language.
  (ii) A language other than English.
  (iii) *Either* mathematics *or* an approved science.
  (iv) At least *two* subjects at the advanced level passed at one and the same sitting together with at least *one* other of the five required subjects. This latter subject must not be 'related to' the other two.

In both the above cases, no subject may be counted at both the ordinary level and at the advanced level. In addition to the above regulations which are those applying to children who leave school at 17/19, there are special provisions for candidates of 23 and over who were unable to qualify at the proper time but who show promise of doing well in a University course. The above constitute the essential university entrance requirements, but the final selection of students for training will be arranged by the appropriate university faculty. It might be noted here that the number selected is in no way governed by the future requirements of schools.

II. UNIVERSITY DEGREE COURSES IN SCIENCE

Upon entering the University a student will consult the tutor to the faculty (or department) of science and opt for either an Honours course leading to the degree of Bachelor of Science (B.Sc., Hons.) or an ordinary course leading to the degree of B.Sc. The Honours course is more specialised than an ordinary course, the work being studied to a higher level. Thus the Honours courses generally attract a more scholarly type of student than the ordinary courses. A first degree course is usually one of three years, but in some cases it extends to four years. At this University the following undergraduate courses are available in the faculty of science.

(1) Mathematics (2) Engineering (3) Physics (4) Chemistry (5) Zoology (6) Physiology (7) Geology (8) Botany (9) Anatomy (10) Psychology (11) Metallurgy (12) General Science.

Most Honours graduates who ultimately decide to train for teaching will graduate in one of 1, 3, 4, 5 or 8 above, although there will occasionally be an Honours graduate in engineering or geology. Some students taking an Honours course may be transferred to an ordinary degree course for a variety of reasons during the three years of study. The following details for the faculty of science are typical.

	1948 Entry	1949 Entry
Number of students starting an honours course	292	280
Number of above students transferred to an ordinary degree course	64(22%)	55(20%)
Number of direct entrants to an ordinary degree course	58	47

Again, some honours students may be awarded an ordinary degree on the results of their honours degree examination.

In all the above courses, at least one other subject must be taken during the first two years of the course, e.g. in the honours school of physics, a student must:

(a) take approved courses in pure mathematics and chemistry during the first year, and
(b) take a further approved course in mathematics during the second year.

The term general science (No 12 above) has a different connotation from that usually attributed to it by science teachers. Thus the honours school of general science is subdivided as follows:

(1) Chemistry, Physics, Mathematics.
(2) Botany, Zoology, Chemistry.

(3) Botany, Zoology, Geology.
(4) Geography and Geology *or* Botany or Zoology.
(5) Chemistry and Physiology with elementary Physics and Zoology.
(6) Anatomy and Physiology (devised primarily for students intending to qualify in medicine.)

In all the above divisions, the subjects mentioned are studied in each of the three years of the degree course, and in most cases some other subject is studied for one year (e.g. Biology in Section (i)).

For the ordinary degree of B.Sc., students must take the final examination in any *two* of the following:

(1) Pure and applied mathematics (2) Physics (3) Chemistry (4) Zoology (5) Botany (6) Physiology (7) Geology (8) Psychology (9) Anatomy (10) Pharmacy (11) Engineering (12) Metallurgy (13) Geography.

None of these subjects is, of course, studied to as advanced a level as for the Honours course.

During the sessions 1952–53 and 1953–54, 35 and 34 science graduates respectively entered the department of education. The following tables show the subjects in which they graduated and, in the case of honours graduates, the class of the degree (i.e. 1st, 2nd or 3rd class honours).

A number of interesting facts emerge from these details. It will be noticed that, of the 69 science graduates in training in the two sessions, only 4 had first class honours. Almost every week some national daily paper or weekly periodical includes articles or letters referring to the grave shortage of science teachers in grammar schools and the fact that very few of the science graduates who have begun to teach since the war have good honours degrees. As a large majority of the country's scientists and many technologists receive their initial training in grammar schools it will readily be seen how serious this problem is. A number of grammar schools have been unable to fill science vacancies, some have recruited teachers trained in Training

	Session 1952–53							Session 1953–54						
	Men			Women			Total	Men			Women			Total
Honours Degrees	1st	2nd	3rd	1st	2nd	3rd		1st	2nd	3rd	1st	2nd	3rd	
Mathematics	1	2	—	—	2	—	5	1	4	—	—	1	—	6
Physics	—	2	—	—	—	1	3	—	1	5	—	—	—	6
Chemistry	—	—	—	—	—	—	0	—	1	—	1	—	—	2
Botany	—	—	—	—	—	1	1	—	—	—	—	1	—	1
Zoology	—	—	—	—	—	—	0	—	1	—	—	1	—	2
General Science (Geology and Geography)	—	1	—	—	—	—	1	—	—	—	—	—	—	0
General Science (Botany and Zoology)	—	2	—	—	4	3	9	—	—	—	1	1	—	2
	1	7	—	—	6	5	19	1	7	5	2	4	—	19

	Session 1952–53			Session 1953–54		
Ordinary Degrees	Men	Women	Total	Men	Women	Total
Mathematics and Physics	9	2	11	2	5	7
Mathematics and Chemistry	2	—	2	4	—	4
Physics and Chemistry	2	—	2	1	—	1
Botany and Zoology	—	—	0	1	—	1
Chemistry and Physiology	—	—	0	—	1	1
Botany, Zoology and Geology	—	—	0	—	1	1
Geology and Geography	—	1	1	—	—	0
	13	3	16	8	7	15

Colleges while others have been forced to drop one or other of the usual science subjects from the school curriculum. It should be pointed out that most of the country's teachers are trained for two years in Training Colleges. These teachers usually teach in primary and secondary modern schools and very few of the small number recruited to the science staffs of grammar schools will have studied science beyond the standard of a first year university ordinary degree course. The following table, comparing academic qualifications of science and mathematics graduates entering the teaching profession for the years 1938 and 1953 for the country as a whole shows a considerable decline in academic quality.

When it is realised that the National Advisory Council on Training and Supply of Teachers has estimated that the number of trained graduate teachers of mathematics and science available annually for grant-aided schools, training colleges, and establishments for further education between 1951 and 1953 is 570, while the average annual requirement for the period 1955–1960 is likely to be 1020, the magnitude of the problem will be realised.

GRADUATES LEAVING PROFESSIONAL TRAINING—QUALITY OF DEGREE IN MATHEMATICS OR SCIENCE *

	Men		Women	
	1938	1953	1938	1953
First class honours	48	18	14	10
Second class honours	148	161	87	92
Other honours	37	52	32	24
Pass (ordinary) degrees	93	224	63	90
	326	455	196	216
First and second honours as percentage of total	60.1	39.3	51.5	47.2
Equivalent percentage for students holding degrees other than mathematics and science	74.1	62.1	69.0	63.1

* From the report entitled "Graduate Teachers of Mathematics and Science" published by Her Majesty's Stationery Office.

A further indication of the present serious position is given by the results of an inquiry in 1953 into the supply of graduate teachers of all subjects in the girls' schools whose headmistresses were members of the Association of Head Mistresses. From girls' grammar schools of various types 550 replies were received. These replies supplied the following information:

	Vacancies Unfilled (%)	Filled Satisfactorily (%)	Posts for Which No Applications Were Received (%)
Physics	More than 30	Less than 50	More than 21
Chemistry	" " 25	60	" " 18

In the case of mathematics from 18 to 22 per cent of the vacancies either remained empty or were filled unsatisfactorily. Further, the term "satisfactorily filled" was used in a very limited sense and reflected the enforced acceptance of a lowered standard.

At the moment, there is no sign of any improvement either in the quality of graduates in training or in their numbers. It should be pointed out, however, that it is still possible in this country for graduates to enter the teaching profession without

training. Many independent schools probably recruit most of their science teachers in this way, but few state schools do so. These independent schools are outside the state system and include the so-called public schools such as Eton, Harrow, Winchester, etc.

Of the graduates trained in this department, there is little doubt that all of them could secure posts in grammar schools should they wish to do so. Most of them would probably be permitted to teach their subjects to G.C.E. advanced level within a few years of completing their training while some teach to this level immediately.

Another interesting fact is the shortage of chemists who have taken an honours degree, there being only two such graduates in the two years. Again, if the numbers for mathematics are deleted from the tables on page 6, it will be seen that only 27 honours graduates in pure science entered this department in the two years.

It is also worthy of note that a science graduate need not have studied any biology either at school or university. Similarly other students may have only the most elementary knowledge of physics or chemistry. This is felt by the science tutors in the department to be a matter for regret, but there would seem to be no possibility of any change at university level as university faculties of science do not arrange courses specifically for intending teachers.

III. PROFESSIONAL TRAINING

Selection of Students for Entry into the Department of Education

During the third and final year of a student's undergraduate studies he may apply for admission to a department of education either in his own university or elsewhere. The selection procedure adopted varies from one university to another. At Manchester, the traditional procedure is for an applicant to be interviewed by three tutors from the department of education. Supplied with details of the academic record of a student and with testimonials and references, the staff attempt to assess the applicant's personality, character and teaching potentiality during an interview of 15 to 20 minutes. For some years now, however, a proportion of candidates has been selected by means of various experimental procedures and investigations are continuing to assess the relative merits of these methods.

Preliminary School Practice

Before entering the department in October, each student is required to practice for at least two weeks in a school of his own choice. This preliminary practice is not supervised by the staff of the department, although it is usually discussed with one of the tutors towards the end of the third year of a student's degree course. In general the tutors insist that this practice shall not be in a grammar school. They also advise the students on how to make the best use of the practice, and generally clear up any difficulties found by students in a pamphlet "Suggestions on preliminary school practice" which is circulated to all students by the department. Amongst other hints, the following are included in the pamphlet.

Here are some suggestions about observations you can make.

(1) Observe the *pupils*. Note the number in the class, their average age and the range of their ages. What do they actually do? For example, they listen, answer questions, do practical work, write, draw, act etc. Compare the degree of attention the children pay to different activities, e.g. to stories, reasoning, demonstrations, practical work. Compare the degree of attention paid to different activities by children of different ages and different levels of ability, e.g. dull, average, bright.

Observe one child particularly during a whole lesson, or during a whole day, including time in the playground etc. Try to study in this way a normal child, a dull child, a naughty child. Note his age, and ask his teacher what is his intelligence quotient if it is known.

(2) Note what the *teacher* actually does.............

(3) Observe *the school* as a society...........

The programme of courses is frequently amended slightly, but the following is a

very close approximation to the general plan.

teaching of their own subjects. The department's emphasis is, indeed, on a broad

PROGRAMME OF COURSES FOR THE TRAINING YEAR 1953–54

Compulsory courses

(1) Philosophy of education	18 periods *
(2) History of education	19 "
(3) Psychology of education	18 "
(4) Health education	12 "
(5) Curriculum and methods	
(a) General method	5 "
(b) The curriculum of the grammar school	3 "
(c) The curriculum of the modern school	4 "
(d) Science	22 "
(e) Mathematics (including arithmetic)	22 "
(6) Tutorials	60 "
(7) Construction and repair of scientific apparatus	5 half days
(8) School visits and demonstration lessons	12 half days approx.
(9) School practice	48 days
(10) One course chosen from: (a) Physical education; (b) Play production; (c) Choral speaking; (d) Local survey; (e) Music; (f) Speech in school; (g) Studio; (h) Visual methods of teaching	15/30 half days

* Period = 50 minutes.

Optional courses

(1) Adult education	26 periods
(2) Appreciation of the environment	7 "
(3) Comparative education	8 "
(4) Film appreciation	14 "
(5) Recorder class	26 "
(6) Rural education	26 "
(7) Spoken French	12 "
(8) Weather study	7 "
(9) Gardening	26 half days

In addition to the above, two weeks after the final examination are devoted to a variety of courses and there are also two residential courses. The first lasts for one week at the beginning of the Easter vacation. During the week, all aspects of rural education are studied at a centre in some predominantly rural county, visits being made to all types of rural school. The other course, of ten days' duration, deals with campcraft and takes place after the examination at a site in the Lake District. Each course is available to twenty to thirty students.

It will be seen from the above that all students spend most of their time in the department attending lectures and discussions which do not deal specifically with the study of education. This emphasis is not always appreciated by students, the majority of whom probably regard school practice as the most valuable part of the training, with method courses ranking next. It is certainly true that a large proportion of science students enter the department feeling that they are at a disadvantage compared with arts graduates. They feel that they are bound to find greater difficulty in writing essays and in the understanding and mastery of philosophy of education because all their training has been much further removed from this type of work than that of Arts students. Whether this is well founded or not, they do take some time to settle down and, at first, are much happier dealing with the material of their method lectures.

Science Method Courses

This course of 22 lectures is divided so that 13 lectures are devoted to what is termed "Science method—general" and three lectures to each of the subject divisions, Biology, Chemistry and Physics. All science and mathematics graduates attend the general course and they are strongly urged to attend all the subject method courses. The science—general course and the biology method course are given by one tutor and the chemistry and physics method courses by two other tutors. This necessitates very careful planning to reduce to a minimum any repetition and overlapping of material. This is further helped by the common practice of all the tutors being present at the lectures. Indeed, it is not uncommon for a lecture to finish with the students and tutors engaged in animated discussion.

Science Method—General

The limited time available and the need to experiment result in the content of this course varying slightly from year to year. However, consideration is always given to the general principles which are felt to be the basis of good science teaching. Similarly, a place is always found for such topics as:

The history and aims of science teaching.
A study of traditional and new methods of science teaching.
Pupil practical work and teacher demonstrations.
Note making by pupils.
Homework.
Examinations—essay type and "new type" tests and their evaluation.
Evaluation of text books.
The teaching of general science.
The value of various associations, e.g. the Science Masters' Association.

The lectures are supplemented by duplicated material including comprehensive lists of appropriate literature both British and foreign. As most of this general course is dealt with before the first period of school practice, the students are given indications of how to prepare lessons for both single and double periods, care being taken to ensure that the students are not given a fixed plan which can be followed slavishly. They are shown how they can make the best possible use of their school practice. At intervals during the course, groups of students are given tasks which they have to prepare and submit for discussion.

One section of this general course may be given in greater detail. It is often found that although science graduates have considerable scientific knowledge and an understanding of a number of experimental techniques, they have but a hazy knowledge of scientific method. Still less are they conscious of the limitations of scientific method, of the nature of science or of the place of science both in the past and today. Time must, therefore, be found to deal with these complex problems and the further problem of how it is possible to teach in order to develop a scientific attitude of mind. This, naturally, leads to problems of transfer of training. The whole of this selection is illustrated with problems taken from every day life.

During the second term, lectures are given on the teaching of biology, chemistry and physics. Once again, time is short but in each course the special problems associated with the teaching of the particular subject are dealt with as thoroughly as possible.

During the session each student has to write a curriculum and method essay as part of the final examination. This essay must be on a subject approved by a tutor and usually varies in length from 4,000 to 10,000 words. The wide variety of subjects chosen frequently includes a large proportion which demand individual work during school practice. At all stages in the preparation of the essays, the students are given all the assistance they require by tutors. The following is a very short selection of essay titles which have been submitted in recent years.

Methods of science teaching with respect to the merits of class practical and the demonstration lesson.

Some problems of the teaching of sixth [1] form biology.

The aims, content and method of a grammar school course.

Trends in the teaching of science in the U. S. A.

During the first two terms science students also attend a course on "the making and repair of scientific apparatus." Although limited in scope, this course provides a valuable introduction to this sort of work. The instruction given in the course is followed up in the laboratory within the department. In this laboratory, apparatus is repaired and made, and demonstration experiments tried out under the supervision of either a trained technician or one of the tutors.

The programme of courses is completed in early June during the period between the examination and the end of term. At this time a variety of courses is provided including works visits, practical work in biology, science in the secondary modern school, etc.

School Practice

From Monday to Thursday of the last five or six weeks in the first term and of the last seven weeks of the second term, all the students move in to schools for practice in teaching. In general, one period is spent in a modern school and the other in a grammar school, with honours graduates frequently spending the longer period in a grammar school.

After a few days of acclimatisation, the students begin an intensive period of training. A time table of teaching periods and periods for observation is worked out by a headmaster, senior science master and a student, who submits it to his tutor when he returns to the department on the Friday of the first week. On the average a student will teach 3 lessons per day, observe 2 or 3 other lessons per day and spend the remainder of each day in a variety of ways to increase his knowledge of the working of a school and, in particular, the role of the science staff. In this way, students become conversant with most aspects of a science teacher's work. For example, they study laboratory organisation, including accident and fire precautions and procedure, the procedures followed for stock taking and the ordering of materials and apparatus, science syllabuses, the science section of the school library, etc. Notes on these things are recorded together with lesson notes and notes on lessons observed in a school practice note-book. Students must also make detailed criticisms of some of their own lessons.

The science staffs of schools play a very important part in this training. They are encouraged to feel that they are an indispensable part of the training scheme whose experience and guidance can be of inestimable value to the trainee. The tutors supervise the work of the students and provide helpful criticism of all aspects of their teaching. Every opportunity is taken to relate the classroom situation to the lectures. This is carried further during the tutorials held on each Friday of the practice period.

Towards the end of the second period of practice, each student is seen by either an external examiner or another tutor. In this way an agreed teaching mark is given for each student on the five point scale A–E. The mark of A or A– indicates that a student's teaching is of distinctive quality while that of E means a failure. An E mark is very rarely given. This is mainly due to the fact that a student who is likely to qualify for this mark (in the opinion of his tutor) is seen earlier, by a second tutor, probably during the first practice. If the two tutors are in agreement, the Professor of Education is informed and if he, in turn,

[1] Sixth forms in grammar schools cater for children from 15/16 to 18 years of age.

agrees with the assessment, the student will be advised to withdraw from the course.

Examinations

Towards the end of the session, an examination is taken for the Graduate Certificate in Education. At the present time this consists of papers in philosophy, psychology, history and health, two long essays and, of course, practical teaching which has been assessed earlier. The two essays consist of the curriculum and method essay previously referred to and one other on topics chosen by the students. These essays are prepared over a period of several months in the students' free time. At the final examiners' meeting the marks are discussed and tutors' comments made use of before a final decision is taken. Students passing the examination are recommended by the Faculty of Education to the Ministry of Education which recognises the course and examination as one qualifying a successful student for recognition as a qualified teacher. Unsuccessful students may sit a part or the whole of the examination in a subsequent session at the discretion of the Faculty of Education. Until this time they may teach as unqualified teachers at a salary which is considerably less than that of a qualified teacher. Before the war these unqualified teachers would probably not have secured posts, but the present shortage of teachers compels some schools to employ them.

SCIENCE AND EDUCATION *

THE SCIENCE MASTERS' ASSOCIATION, GREAT BRITAIN

THE Committee of the Science Masters' Association commends the following policy statement to your consideration.

INTRODUCTION

The effects of science on human life and thought have become so great, and are potentially so much greater, that no one who does not understand them, and the science which produced them, can be considered properly educated or cultured in the sense of being able to participate fully in the life of his time. Science must be recognized and taught as a major activity which explores human experience and then maps it, methodically but also imaginatively, so as to make coherent, reliable and communicable sense of it, as a cartographer makes similar sense of a tract of country. Each science or group of sciences is concerned with only a limited aspect of human experience abstracted from the whole. As a human quest for Truth—and it is much more subjectively human than is generally realized—science is concerned with one of the main Values and qualifies for the status of an active humanity. The schools, therefore, have the duty of presenting science as part of our common cultural and humanistic heritage; it should be taught in harmony with, not in opposition to, the various Arts subjects which alone have hitherto been regarded as humanities. Such a presentation will help to produce a climate of opinion in which science can flourish, and in which scientific advances can be applied for the common good.

This primarily cultural responsibility is no less important than the duty, universally and, we believe, rightly accepted by grammar schools at present, of providing preliminary vocational training for the minority who will become professional scientists and technologists; yet so far science has not been given its proper place in general education. This situation should be remedied forthwith.

EDITOR'S NOTE: This is Policy Statement by the Committee of the Science Masters' Association of Great Britain made in November, 1957. The Science Masters' Association has a membership of over 5,000 science teachers and is concerned solely with the teaching of Natural Science in Secondary Schools.

RECOMMENDATIONS

We maintain that science should be regarded as a central or "core" subject in the same way as, for example, English and mathematics are at present and as classics used to be. Our immediate concern is with the "grammar school" type of education,[1] and we recommend:

1. That *all* pupils should follow the same course in science up to the end of the fifth-form year, that is, to the standard of the Ordinary Level examinations of the General Certificate of Education. As stated below ("Phase II") the course should cover at least the three main subjects of school science. The depth to which it is taken should depend on the abilities of the pupils, and not at all on the subjects in which they intend to specialize; in fact there should be no division into science specialists and arts specialists at this level, and specialization in arts or science subjects should be equally available to every pupil on entering the sixth-form.

2. That science should be studied by *all* pupils in the sixth-form. We have in mind, not the specialist courses leading to the present "A" Level and scholarship examinations in science subjects, but science studied as a humanistic and cultural subject with the aims mentioned above and further discussed under "Phase III" below.

3. That subject-specialization should be retained in the sixth-form, but that "A" Level syllabuses should be reduced in factual content in order to allow sufficient time for the cultural course proposed in Recommendation 2. We also welcome the possibility of mixed Arts-Science groups of main subjects being taken in the sixth-form, for example, Latin, History, Physics.

We realize that our recommendations raise many problems. New syllabuses will be required; some topics which were of considerable importance in the nineteenth century will have to give place to others (for example, atomic and electronic physics, biochemistry, genetics) of greater importance in the twentieth. Teaching methods may have to be revised; in particular, considerable thought will have to be given to sixth-form science courses. Examinations will have to be considered; we do not expect that pupils will attach much importance to subjects, however desirable, which are not examined and which do not seem to have obvious and immediate relevance to their subsequent careers. These and other matters will be considered in a full Report which a sub-committee of the Association will produce.

We recognize that the country requires more scientists and technologists for all purposes, and we believe that our recommendations tend towards achieving that end. Moreover we are particularly aware of the urgent need for greater numbers of science teachers. Successful teachers of any subject must have a special interest in personal relationships, and it seems likely that, if more emphasis is laid upon the cultural and humanistic sides of science education, more young people may favour science teaching as a career.

The remainder of the present Policy Statement expands the recommendations given above by considering three stages or "Phases" of grammar school science education, namely:

I. Introductory phase, covering the first two years of a grammar school course.

II. Intermediate phase of three years up to about sixteen years of age, when the Ordinary Level examination for the General Certificate of Education is taken.

III. Advanced (or sixth-form) phase, including a general course in science as a cultural and humanistic study, together with Advanced Level courses in science subjects for science specialists.

I.

Introductory phase covering roughly the first two years of the grammar school course.

This should comprise a broadly based course of Natural Science (Physics, Chemistry, Biology and, probably, Astronomy[2] taught on a topic basis. The topics chosen should arise from the child's interests and experience; they should open up fresh fields of enquiry and give a new outlook on familiar things. Scientific curiosity should be encouraged and developed by an observational and experimental treatment. Children are eager to do things for themselves and should be guided rather than thwarted; the opportunity should be seized for culti-

[1] The special needs of Secondary Modern Schools are considered in the Association's report *Secondary Modern Science Teaching*, Parts I and II.

[2] Geology is, perhaps, best studied with Geography.

vating the practical skills which will be needed later. The work should be mainly qualitative; measurements should not be made for their own sake but only when the need for them is felt to arise, and then they should be simple. "Visual Aids" will sometimes add interest and bring reality into the classroom, but, in so far as they do not lead to activity on the part of the children, they should be used sparingly. They may, for example, be valuable in classwork in Astronomy but in any case this study should lead to observations made outside the laboratory.

In the Primary School most subjects are taught by one "class teacher." The child entering the Grammar School is faced with new surroundings, new classmates and, probably, an array of subject teachers. Introductory work in Science should be in the hands of one teacher only, whose ability to teach in an interesting and stimultaing manner is more important than his academic competence.

The main objects at this stage are, firstly, to maintain and extend the child's natural interest in science, and secondly, to instil good habits of learning and good laboratory techniques, and to give good training in the use of simple descriptive English. Acquisition of factual knowledge is not a principal aim, but many basic facts will be learnt and the "orderliness" of science should become apparent. Although a "topic" method is used, each topic is a logical and satisfactory whole and leads on to new topics. The more systematic study of science as an intellectual discipline begins in Phase II.

II.

Second or intermediate phase, extending over three years, to sixteen years of age.

Whilst we consider that the whole course should extend over seven years for all pupils, we recognize that, for some time yet, there will be a substantial number leaving at age sixteen. In consequence of this, the second phase must be complete in itself, as well as being intermediate in a course extending for at least two more years.

The work in the main should be composed of physics, chemistry and biology, opportunity being taken, where possible, to emphasize their inter-dependence. The total time devoted to the science subjects should be the same for all pupils in a school, irrespective of their intentions regarding future specialization. The standard reached at the end of this phase will depend, however, on the abilities of the pupils. The more able pupils should reach the "O" Level standard in each of the three main branches of science, while others might be examined on a two-subject (perhaps with papers in Physical Sciences and Biology) or on a one-subject basis. Whichever course is adopted, importance must be given to each branch; it is not sufficient for pupils to study, say, physics only.

This part of the course must be rooted firmly in practical experience of the type which uses experimental work as a means of solving problems, rather than for mere verification of previously stated facts, and in which due stress is laid on the importance of correct techniques. Practical work should lead to the formulation of empirical laws and hypotheses, and, eventually, to simple ideas of great and far-reaching generalizations such as the kinetic and atomic theories. In this way, science can be shown to be a systematic study, resting on sound and logical foundations. Throughout the course every opportunity should be taken to relate the facts and principles to everyday life and experience; judicious digression to discuss matters of immediate topical interest can be most valuable.

At the end of this second phase pupils should have some appreciation of the methods of science and of the scientific attitude; they should perceive, to some extent at least, the importance of distinguishing clearly between observational facts and the generalizations arising from them on the one hand, and, on the other, theories which may be no more than convenient fictions. They should also begin to comprehend science as a major manifestation of the human

spirit, although full understanding cannot come until a later stage.

III.

Advanced phase, covering the sixth-form or "pre-university" years, and including course "A" intended for all students, and course "B" intended, as at present, for science specialists.

A. We propose a broadly based course embracing the history and philosophy of science, its present-day social and technological consequences and its future possibilities. It should examine the origins and trace the development of some of the major, currently-accepted concepts of science. It may include topics such as cosmology, evolution, heredity, man's command over sources of energy, and the effects of technology on society. There may perhaps be a place for some introduction to psychology and the social sciences. Finally, possibly by a close study of a few sequences (or "case-histories") of scientific discovery, there should be a conscious examination of the methods by which science progresses and of the limitations of these methods.

We attach great importance to this development of sixth-form work, and we recommend that it should be examined, in the first place optionally as part of General Papers (such as are already set by some Examination Boards), and also as an optional subject at "A" Level. As the subject becomes more firmly established, and the necessary numbers of teachers become available, we envisage that there will be some degree of compulsion placed upon candidates to answer science questions in General Papers or to take a separate paper in a subject such as "The History and Philosophy of Science." We recognize that sixth-form teachers will need to equip themselves for this work, and we hope that courses will be made available.

B. *Specialist Studies.* We have considered and rejected arguments foı complete abolition of specialization in schools. We are satisfied that most students are ready and eager to go deeply into a few chosen subjects and that they wish to be intellectually extended. Nevertheless the student should be brought to realize that the subjects of his specialized studies are but a fragment of all knowledge and that, to be a good specialist, he must have sympathy with and some understanding of other modes of human thought and endeavor.

We are opposed to any narrowing of the field of specialist work by reduction in the number of Advanced Level subjects studied and submitted for examination. The time has come for a reappraisal of teaching and examination syllabuses, and we recommend a reduction in the content of these syllabuses, not by sacrifice of depth, but by reduction in the width of the factual knowledge at present required.

SUMMARY

We consider that science must be recognized and taught as a major human activity and as a cultural study of supreme importance because of its effects on human life and thought. The aims of science teaching should be:

(a) to lead pupils to observe, and to solve problems by controlled experiments, to draw conclusions from observations, and to appreciate the systematic laws and principles of science,

(b) to give knowledge and understanding of the origins and development of science, of the achievements of scientific pioneers and of the implications, now and in the future, of modern scientific and technological developments,

(c) for science specialists, to provide a suitable preparation for further scientific or technological education.

We therefore recommend:

(1) that *all* pupils should devote the same time to science subjects up to the end of the fifth-form year.

(2) that *all* sixth-form pupils should follow a cultural course in science, principally with the aims mentioned in (b) above.

(3) that subject-specialization should be retained in sixth-forms, and that science syllabuses at Advanced Level should be reduced in factual content.

These recommendations raise many problems of syllabuses, of teaching method, of suitable training for science teachers, and of examinations. These matters will be considered in a future Report.

SCIENCE TEACHING AND GENERAL EDUCATIONAL IMPLICATIONS IN INDIA—1959 *

STANLEY B. BROWN
University of California, Berkeley, California

AND

L. BARBARA BROWN
San Jose State College, San Jose, California

INDIA has long been known as a land of contrasts. One must visit the country to realize the full meaning of this statement. It is apparent in many ways. To a visiting American perhaps the most outstanding contrast is the problem existing in this newly independent nation to find its place in the fast-moving world of 1959 while the bulk of its people practice the slower pace of ways of life that are sadly out of tune with Modern Progress, however quaint and charming they may be.

In an undeveloped land of 385 million people of which only 18 per cent are literate, education at all levels to meet the demands of a country seeking present day recognition poses tremendous problems. The circle is a vicious one. Free India needs education to expand and improve its dynamic political, social, and economic needs. At the same time it needs these dynamic forces to expand and improve its educational system. Where to begin?

The task is not an easy one because they are racing against time. To be suddenly placed in competition with other nations that have slowly and steadily developed efficient social, political, economic, and educational programs to the working level of 1959 only further intensifies the problems of India. There is no room for discouragement in the hearts of the Indian people. They are FREE. The almost overwhelming task of developing their country to its full potential is a challenge that is being faced with determination and an understandably emphasized spirit of nationalism.

To our manner of thinking, the education system could be criticized as totally inadequate in meeting the needs of the country as a whole. It is one thing to openly criticize it in comparison to ours—it is another thing to attempt to understand India's plight and to view its present day educational system in terms of what forces have been at play in India's past history, and what plans are being devised for the future. India is a very old country, but she is also a very new one. As such, she must not be as much cruelly criticized for the perpetuation of her old ways as understood and respected for attempting to learn and establish new ways.

It takes Time.

Thus in presenting the status of India's present day science teaching and general educational program, the authors will attempt to objectively view it as a terminal state of affairs that exist now because there just has not been time in this "young" country's existence to devise plans for measurably improving it. True, it is not adequate, but India is only scratching the surface of its development. The education system will of necessity grow with the country.

In years past, the British introduced a formal system of education in India consistent with such objectives as producing assistants who could help in clerical jobs and similar vocational pursuits. India, now free, demands citizens with critical intelligence for efficient responsibility and participation in self-government as well as world citizenship. To meet the needs of these

* Based on senior author's experience as Fulbright Visiting Professor in India 1954–55. Special emphasis was on workshops in elementary and Secondary Science. Mrs. Brown participated in the Elementary Teacher Education workshops.

new goals and values, a new approach in science teaching and higher education must be introduced in Indian schools.

Of the many and varied kinds of schools in India, two major types may be noted—the British-influence traditional and the Mahatma Gandhi-inspired "basic." Unfortunately, a firm authoritarian method of teaching is imposed on all levels in most schools. The overall picture includes an elementary program corresponding to our grades one through six, known in India as Standards through VI, both traditional and basic. Science teaching at the elementary level consists of nature study with heavy emphasis on a textbook centered program. In studying about water, soil erosion, hydroelectric dam projects and the like, the writers found little reference to activities that were being carried out in the immediate locale by spectacular Government of India projects and Technical Assistance Programs (International Cooperation Administration—U. S. Department of State). However, the natural curiosity of many children was in evidence and teachers are being asked questions that demanded answers—science centered questions that will, in time, alter the rather rigid scope of elementary science concepts.

Science teaching at the secondary school level was for the most part highly theoretical and predominately physical science oriented. Fortunately steps are being taken as a result of The Commisison on Reorganizing The Science Portion of Secondary Education Program to promote and expand science and technical education offerings. In addition to a revamp of specific and rigid science content programs to one far more in line with current concepts here in America, it was most gratifying to also note the instituting of rather extensive financial grants, merit scholarships regardless of family station (no small hurdle) and post-matriculation grants to competent and needy students. Upgrading IS taking place in science teaching via (a) special receptions in the *Rashtrapati Bhavan* which are attended by the President, the Prime Minister, Education Minister and other important persons. (b) Seminar-cum Summer Camps that are extensive in-service programs for promulgation of improved science teaching and (c) Professional conclaves, conferences, conventions jointly sponsored by teacher education science methods staff members, experienced teachers and lay scientists. The All-India Council for Technical Education and the University Grants Commission members are keenly interested in a more realistic approach to science teaching at the secondary level. Hitherto withheld sanction has now been recommended with the result of many excellent three dimensional models, mock-ups, and other audio-visual materials replacing the previously held theoretical approach. The excellent report by the Commission on Reorganizing the Secondary Education Scheme by Dr. Lakshmanaswanri Mudaliar endorses this *New* approach. The secondary program continues through the equivalent of our 11th grade, or Standard XI, also traditional and basic. Results of the terminating external examination at this point determine whether or not a student will be allowed to continue for an advanced degree in a university or other institution of higher learning. Provisions are being made to extend the secondary program another year; thus, it appears that a 12 year educational pattern will be universally adopted throughout India.

The content in traditional schools is not in harmony with the interests and needs of learners. It tends to be academic, abstract, and formal. This teacher-dominated atmosphere is generally verbal and emphasis is on rote memorization, question and answer techniques. An undue emphasis on external examinations still prevails and actually is one of the controlling factors of teaching methods—a major disadvantage that American educators were forced to deal with at the turn of the century.

The Minister of Education of the Government of India has adopted a program that was inaugurated and developed by Mahatma Gandhi. This program, known as "basic

education," places emphasis on correlation of general knowledge with a selected productive craft. These schools are attempting to help the learner develop latent talents to be used in the cottage industries throughout the country. This is fundamentally a vocational education—a necessity in a heavily populated country in which overnight industrialization would literally starve out millions of people. A complete changeover from a centuries old way of life to a stepped up modern industrial nation would raise havoc with the entire structure of the nation. The basic education program is presenting opportunities of learning small business livelihoods for thousands of people who, under outmoded caste systems, were not allowed to step beyond the miserable conditions imposed by their inherited caste level. By declaring the old caste system illegal and unconstitutional and attempting to educate the younger generations to select a vocation in tune with each individual's capacities, a major step has been taken in the direction of developing a heretofore unknown pride in and desire for personal initiative—a much needed concept if the necessary bulk of people are to be encouraged to work not only for a daily bowl of curry and rice but for a prosperous India. This system, however, emphasizes a manual craft labor and all too frequently neglects an overall mental development. A modification of both traditional and basic school systems is necessary in order to satisfy the many requirements of effective citizenship in this "new" free country.

A study of India's total educational picture yields many facts and problems that are not entirely foreign to us in reviewing the development of education in our own country. Today the deterring factors in India seem perhaps more intense because of the ever present comparison between its society and ours. Some similar problems we have satisfactorily met, others we are also hoping to improve. Again, perhaps as Americans, we are inclined to more readily compare these two societies especially after literally dropping from the sky from a very up-to-date society into one that appears predominantly to resemble a live TV production of past history. But this is not fiction—the people, the country, and the problems are real. They cannot be summed up and solved in an hour of discourse and action.

Americans pride themselves on moving into a situation, sizing up the problems, and recommending that this or that be done immediately to alleviate pressures. This works fairly well in our own country because we have gradually built up resources and a highly coordinated system of making these resources available where, when, and how needed. If we grow impatient with the Indian's apparent failure to realize the importance of speeding up all educational facilities, it is only because we fail to remember that we did not accomplish this overnight either.

What are some of the problems? No attempt will be made to present these in a sequence of importance because every facet of the total problem is of almost equal importance.

To the casual observer, the first thought is financing adequate facilities. The visitor's first day in Bombay or Calcutta could easily cause him to throw up his hands in anguish for the conscientious Indian educator's task of trying to educate the masses. To be caught in the after-business traffic rush on the Howrah Bridge in Calcutta should perhaps be enjoyed after the visitor has learned to know India. In a way it personifies India. Here, every known means of conveyance is packed and jumbled into a raucous, disorganized bedlam of teaming masses of people attempting to only get over the bridge. Howrah Bridge is a bottleneck surging with the explosive tempers of possessors of bogged-down automobiles or motorcycles; but subdued by the infinite patience of owners of rickshaws, horsedrawn stage coaches, oxcarts, or the plodding pedestrian straining under magnificient head loads. This is India—the "new" simply cannot impatiently push aside the "old" no matter how loudly or constantly it blats its horn.

Education facilities cannot expand or progress any faster than the social, political, or economic structures of the country permit. Before formal education can be financed and made available to every one of the hundreds of thousands of children wandering the streets of densely populated areas or to those in remote, primitive villages, the condition of revenues must be improved. For a time, formal education must reach as many as possible with a view toward spreading these learnings by word of mouth and through the process of imitation. This concept must be understood, otherwise the many fine schools already in existence would seem totally inadequate in terms of the ratio of young people exposed to education versus those that stare longingly over the walls surrounding school edifices but never enter the portals.

In cities like New Delhi, or Calcutta the problem of supplying science facilities to meet the theoretical demands of free and compulsory education for all is intensified by the recent migration of hordes of refugees flocking to these areas following the partitioning of India and Pakistan.

Until industry and transportation facilities are further developed, the high cost of essential building materials can deter the expansion of needed school plants and facilities in both city and village areas.

The educational problems of the agricultural villages is apart from those in cities. Free and compulsory education to age 14 in the densely populated areas in theoretically existent but impossible to enforce simply because there are not the facilities for housing the thousands of children. Taxation for support of schools has not yet reached an efficient form. A great bulk of the city population owns no property and earns barely enough to support the minimum of bodily needs. As business and industry develop into more highly organized forms, this revenue problem may be alleviated somewhat. Considering the overwhelming population for which educational opportunities must be provided, the surface of this problem has barely been scratched.

The children of India possess a natural eagerness to learn about science. In tribal villages where no written language exists, ancient educational methods are in vogue. Here under a shady tree the village elders (Panchayats) teach the ancient tribal heritage and customs to the youngsters circled about them by way of verbal folklore and folk songs. Occasionally, in some of these remote areas a dedicated teacher can be found who is striving to bridge the gap between this rudimentary education and a basic introduction to the fact that a world does exist beyond the village walls or the local market-town. This process is discouraging because educational facilities are slow in reaching the tens of thousands of remote villages (550,000) spotted over the countryside. In some of these areas, depending upon the availability of an enlightened educator, a type of coordinated school district is formed. Since teachers are scarce and financial support of organized schools in village areas is almost non-existent, several villages may select a central location with a single teacher who serves the children of the outlaying villages. Much has to be done in overcoming the difficulties of bringing organized education to the millions of village dwellers, but the need is recognized and the slow process is beginning.

India is a country of many dialects and varied tribal customs. To the man in the field, the villager, the needs of daily existence are met within the confines of the village unit. To him there is no urgency connected with unifying or expanding his country. His wants are simple and his daily life is simple. His pattern of living is little changed from that of his predecessors hundreds of years ago. His immediate educational need lies in an agricultural program to increase his farming productivity. Again, this is a tedious and vast process; but the need is recognized and the expansion in this direction is under way. Today, since India's agricultural masses must devote the greater part of their energies to

primitive ways of providing food, shelter, and simple clothing, formal education seems of less immediate consequence than a vocational education to improve his standard of living.

In the northeastern state of Bihar, for example, the Damodar Valley Project will alter considerably the living pattern of local residents, most of whom have been agriculturalists. The tremendous dam will control and divert the ruinous flood waters. Eventually, an irrigation system will reach the sometimes arid and otherwise disastrously flood eroded plains thus assuring the farmers of stable crop seasons. A hydro-electric plant will provide for further expansion of the steel mills at Jamshedpur in addition to development of more effective mining and processing plants in this area of rich but unexploited mineral resources. As more efficient farming practices are involved, the need for entire families to produce merely enough food to exist will be eliminated—many young people will turn to industrial work. Schools will be needed to train the young people in methods of modern agriculture as well as scientific and industrial vocations.

Further expansion of schools is not only limited by financial reasons, the teacher shortage is acute. India's present schools are understaffed and youth are not responding to the need for more adequately trained teachers because of the unfortunate socio-economic status of India's teachers.

The professional status of teachers (including science teachers) is peculiar. Although the municipal leaders recognize the important professional activities and responsibilities of Indian teachers, the socio-economic status remains at a "service" level. An average salary of only 125 Rupees per month ($26.25) forces many teachers to resort to "tuitions," private science tutoring of pupils for additional money to meet family obligations. This over-burdened time factor prevents many otherwise competent science teachers from devoting their energies to improving classroom techniques as well as further broadening of their own qualifications.

Science teachers' salaries do not entice young people to devote their hard won educational opportunities to training for a profession that requires living at a marginal level. In spite of the non-materialistic theme in the philosophy of Indian people, there is a growing awareness of the factor that men and women engage in more productive financial vocations likewise enjoy a more enviable position. Yet the need for leaders in numerous other professions demand a competent force of teachers to provide the necessary preparation. Improving the socio-economic status of the teaching profession to attarct recruits who will in turn aid to training technicians and leaders in all professions is a major consideration. It will become more obvious as business and industry expands.

Through the combined efforts of India's three 5-year programs, international teams of experts from the United Nations, World Literacy League, ICA, Columbo Plan, Fulbright Program, Ford Foundation, missionary activities and similar endeavors, the very core of such problems as have been listed above are receiving much attention. One of the most promising landmarks on the horizon is the adoption (in a pilot project) of a multi-purpose curriculum in 500 secondary schools throughout India. The diversification of courses, activities, and new approach is the beginning of potentially functional programs at functional at vocational, technical, and industrial secondary school levels.

True, the enormity of both existing problems and their complex remedies require the combined efforts of all. Yet, despite such serious limitations, the overt energy, willingness and determination of so many Indian science teachers and educators can not help but bring about a future chapter that will shine forth with hope and faith for the betterment of all men in this new Nation among Nations—

Free and Democratic INDIA.

SCIENCE EDUCATION AND TECHNICAL COOPERATION WITH SPECIAL REFERENCE TO AFGHANISTAN *

WILLARD J. JACOBSON

Teachers College, Columbia University, New York, New York

IN technical cooperation circles, the following dialogue between an American agricultural specialist and an Indian interpreter-counterpart is sometimes related when specialists discuss ways and means of making their maximum contribution through a program of technical cooperation.

Singh, a brilliant Indian interpreter-counterpart, and Pete, a young competent American agricultural extension worker, were close friends and had done some very fine work together. They lived and worked together and had had numerous conversations on subjects ranging from international affairs to the relative merits of various brands of tea. Their conversations sometimes mirrored the broad general aims of technical cooperation in specific, concrete terms in which the generalities become effective.

Singh: "You American specialists are a fine lot and we admire and treasure your friendship and willingness to help, but you really don't understand Indian customs and Indian life."

Pete: "I guess you're right, Singh. To truly understand Indian life and Indian customs one would have to have lived in India for a long time."

Singh: "We respect your knowledge of tractors, power machinery, expensive insecticides and complicated ways of improving and increasing production, but much of it won't work in India where most of the farms are small and very few people would have the means to buy expensive machinery and costly chemical products. We Indians know much more about Indian agriculture and what can be done to improve it."

Pete: "We realize that the methods and machines that have been used in the United States cannot be used in the same way, if at all, here in India. I am becoming more and more aware of the fact that you and your colleagues know much more about Indian agriculture than I do."

Singh: "There are important cultural factors that must be considered in agricultural development. Since we have lived here all of our lives, we are much more sensitive to these factors than you could possibly be."

Pete: "Singh, I know that you are right about all of these matters."

(Pete begins packing his bag.)

Singh: "What are you doing Pete?"

Pete: "I'm packing my bag, and I suspect I'll go home. I agree with you one hundred per cent. I know that you know much more about Indian culture, Indian life and Indian agriculture than I do. I left a good job to come here. I think I'll go back to it."

Singh: "Now, now Pete don't do anything hasty. We need you here."

Pete: "But, I agree you can do all of these things better than I can. I can see no reason why I shouldn't go home."

Singh: "But, you've done a great deal here."

Pete: "What?"

Singh: "Well, for one thing, since you've worked with our department, our appropriations from the central office have been increased sixty per cent."

This conversation illustrates that a program of technical cooperation can mean many different things to different people. To some people, it may mean sharing of experience, technical skills and technological know-how in order to help another country in its development. A host government may feel that this is a way to get the technical advice and economic support that is needed to push ambitious plans to fruition. To the man on a lower echelon, it may mean increased recognition and larger appropriations for his department and, perhaps, opportunities for further study, personal development and subsequent advancement. Sometimes lost in the maze of purposes and plans is the important fact that, through technical cooperation, thousands of specialists of many nations have an opportunity to share information, exchange views, work together, become friends and engage in countless frank discussions such as the one

* Based on the author's observations while in Afghanistan June 14, 1954 to April 16, 1956 serving as consultant to the Royal Afghan Ministry of Education. The author was a member of the Teachers College, Columbia University Teacher Education team which was supported by a grant from the International Cooperative Administration.

that took place between Singh and Pete. For two years I had an opportunity to participate in many such activities as a member of a technical cooperation project in Afghanistan. From these experiences and a few observations of work in other countries have come some ideas concerning the contributions that a specialist in science education can made and some suggestions for methods of work in a program of technical cooperation. The experience is admittedly limited, this is merely an attempt to share it.

Technical cooperation is the sharing of knowledge and know-how among peoples. The purposes or motivations of the people involved in programs of technical cooperation may be many and diverse. The purposes of the agencies or organizations engaged in technical cooperation are usually quite explicit and most often stated in terms of economic and social development. For the United States Operations Mission to Afghanistan, for example, the purposes are stated simply and succinctly, "It is (1) to provide assistance in those fields of activity which are basic to the country's economic and social progress, and (2) to provide such assistance in a manner which will insure maximum lasting effects." [1]

The benefits from these programs, however, are bilateral. We assist in economic development of other countries. The benefits for them seem clear. Too often, we neglect to recognize the benefits which we gain. We gain, perhaps quite significantly, from the fruitful experiences of hundreds of our technicians from dozens of different areas of specialization working in scores of countries where conditions may vary as much as is possible upon our earth. The soils specialist who works with people who till soil that has long since lost its topsoil may gain insights that will be of great value to his profession and to all of us. Is it not possible that the irrigation engineer who helps the people of South Asia develop some of their thirsty desert land or the audio-visual expert who has to make the most of the few construction materials at hand may have a unique contribution to offer when they return to their work in this country? How about the educator who works in a country where the opportunity for an education is rare and prized? Will he be able to approach our problems with an enriched background and more fertile point of view? It is conceivable that our benefits may be as great as our contributions.

Technical cooperation can be of benefit to many, including ourselves. Much of the responsibility for success, however, rests on the shoulders of the individual specialist and the people who work with him. He has very little to turn to, however, for suggestions and guidance. It is an understatement to say that there are few reported experiences of technical cooperation in a field such as science education. However, as more and more experiences are reported, the specialist in science education in a program of technical cooperation will be able to build upon what has been learned by others.

Science Education in Technical Cooperation. The major goal of technical cooperation is economic development, and the most important tools for economic development are the result of work in science and technology. In most of the so-called underdeveloped countries, the major industry is and will be agriculture. How can agricultural production be increased? Basically, there are two ways. One is to increase crop yields per acre. The introduction of hybrid seed corn into our midwestern corn belt in many cases more than doubled the yield of corn per acre. The introduction of Japanese strains of rice into Southeastern Asia has more than doubled the yield of rice per acre. Similarly, greatly increased yields per acre often are obtained when fertilizer of the right kind and in the right amount is added to the soil. To increase crop yields in these ways requires considerable knowledge of the requirements for

[1] *United States Assistance to Afghanistan.* A report prepared especially for the Study Mission of the Committee on Foreign Affairs of the House of Representatives. p. 2.

plant growth, seed selection and a mastery of the techniques of hybrid seed production. A second way to increase agricultural production is to open up new lands to agriculture. Land development, however, requires a knowledge of soil survey methods, the engineering know-how needed to construct dams and irrigation canals, and an understanding of how to prepare saline soils for planting. These are examples of the application of principles of science to the problem of increasing agricultural production. Numerous other examples could be given in the fields of industrial development, mining, forestry, electric power, health, sanitation, animal husbandry, transportation and the search for new sources of energy.

There must be general understanding among farmers, laborers and other people of some of the principles used in development. For example, with proper leaching and drainage saline soils can be made fertile. The general procedure is to leach the salt out of the soil by applying large quantities of water. As the water soaks through the soil it dissolves the salt. The water containing the dissolved salt can be collected in drainage ditches or tile drains and allowed to run off the land. But, water is precious, and there have been instances when farmers have dammed drainage ditches in order to get water for their land. Actually, they applied salt to their land. Why? Evidently, the farmers did not understand why the water that had soaked through the soil should be conducted away in drainage ditches. In complicated land development projects, it is important to have competent irrigation engineers, hydrologists, soil scientists and agricultural extension specialists, but that isn't enough. All of the people involved must have some understanding of the scientific principles basic to land development.

In almost all projects for economic development, there is a need for a group of highly competent scientists and engineers and a larger group of skilled technicians. In addition, the farmers, miners, craftsmen, workers in industry, and homemakers must have some understanding of the scientific principles involved in the development project. It is little wonder that most of the organizations engaged in technical cooperation place considerable emphasis on science education.

Specialists in science education can also make a contribution in developing a positive approach to problems. For example, there is very little than can be done if people look only to the after-life for their rewards and are little concerned about the problems of here-and-now. Or, if all hardships and travail are seen as the will of a supernatural being and men cannot or, perhaps, feel that they should not do anything about their hardships, then little can be done until a beginning is made in developing a more positive and hopeful attitude toward difficulties. Usually, the science specialist does not fling out the gauntlet of challenge to these attitudes and beliefs. Instead, the slower way of demonstration is more effective. By showing that some problems can be overcome and life here-and-now can be made a bit more tolerable by the application of some of the things we know about such fields as health and sanitation, science teachers and specialists can demonstrate that it is practical to work for better conditions here-and-now. Usually, there are many that are receptive to the demonstration.

The importance, even necessity, for freedom of inquiry and communication in science has widespread application. As the importance of these freedoms are demonstrated in the areas of science, the implications of this approach for those who must deal with problems in other areas are often perceived. The rigor of the search for facts rather than fantasy and the need to describe what actually does happen rather than that which we wish had happened has important applications in many other fields as well as in the natural sciences. These attitudes and approaches to problems cannot be imposed by official

decree; they must be demonstrated and accepted. The science educator can help provide demonstrations so that others can accept and apply them in other fields.

Contributions of the Specialist in a Program of Technical Cooperation. The success or failure of a program of technical cooperation rests on the shoulders of specialists in fields ranging from highway engineering to community development, from hydrology to education. The specialist can make three major contributions. One, he can help put into practice principles and generalizations that have been proven by the experiences of many men in many places and which seem to be of universal applicability. These principles and generalizations may range in profundity from the principles of how to use a certain tool or piece of equipment to the most abstract scientific generalization. Two, the specialist can bring to his associates and colleagues the benefits of a wide range of experiences which may help them to choose wiser courses of action. These experiences that are introduced into discussions and planning may range from descriptions of how a certain lesson has been taught by other teachers in other countries to explanations of how institutions and programs of study have been developed and the results that have been derived from them. Three, the specialist can demonstrate a method of work that will enlist the energies of many people and can be used successfully by his associates. The development of an effective method of work may be the most lasting contribution the specialist can make.

1. Applying Established Principles and Generalizations. This contribution is of particular interest to the specialist in science education. From one point of view, science is a continual search for more and more inclusive generalizations. To a large extent, a program of technical cooperation has to be based upon the assumption that established principles and generalizations have wide, perhaps universal, applicability. If similar conditions exist, that which works in one place in the world should have a strong probability of success in all other places. Many of these principles and generalizations have been established within the last few decades. The specialist can help spread and speed the application of these principles and generalizations in regions and countries where they have not been used.

This aspect of technical cooperation can be most clearly illustrated in fields of natural science. In the field of public health, the germ theory and other foundational theories for the control of disease have been developed within the last one hundred years. (Pasteur did his basic work less than a century ago. Many of our most effective drugs have been developed within the last two decades.) It is only within the last fifty or sixty years that large scale application of these theories has been made. In this comparatively short time we have had spectacular results. In the United States the average expectation of life is now almost 69 years. In many places in the world, the life expectation may be not much more than half of this figure. Most of the theories used in attaining our spectacular results are universal and can be and have been applied in many parts of the world. Specialists in the field of public health have performed a great service by helping people all over the world to apply these principles to make healthier living possible.

Are there similar principles and generalizations in the field of education? It is difficult to identify them. Many students of education agree upon a theory of transfer of learning. "The extent of transfer of learning from a learning situation in school to practical affairs outside the school is dependent upon the degree to which the learning situation in the school is related to the practical affairs outside." The application of this principle has led to significant results. However, the results are not as striking as those that have been achieved in the field of public health. Later, in this paper it is suggested that the method of cooperative planning, involving all those

who have a stake in a decision in the process of making a decision, may be a principle that has wide applicability.

2. Providing a Broader Base of Experience. Decisions are made and plans have to be formulated and put into action. Usually, we get better decisions and more fruitful plans if they are based upon extensive experience. The specialist in science education usually has devoted some time and energy to the systematic study of problems in science education. He has had teaching and, perhaps, administrative experience in schools in his own country. He can draw upon these experiences to help his colleagues in the host country reach wiser decisions and develop more fruitful plans. Most of the contributions of a specialist in the field of education are of this kind.

3. Demonstrating a Method of Work. Demonstrations have always been important in technical cooperation. To describe how something can be done is important, but it is not enough even when teaching in our own country, where everyone speaks the same language. In situations where discussions must be carried on in two or more languages, the demonstration becomes even more essential for communication. The demonstration may be of how to set up a terrarium for a primary school classroom, or how to plan for and administer a workshop for teachers. Demonstrations of workshop methods are especially important because they provide the participants in a workshop with a method that is useful in dealing with educational problems in general. We will describe some features of the general method that was used in Afghanistan.

Developing a Program of Science Education. The specialist in a technical cooperation program is under considerable compulsion to produce. Some of the compulsion is derived from the great needs that usually are apparent to anyone with eyes to see. But, "What should be done first? How can the specialist make his greatest contribution?" In most programs, both the host government and the sponsoring agency whether it be U.N., U.S., or private agencies, are diverting considerable money to the projects in which the specialists are involved. After a great deal of discussion and deliberation, they have decided that the greatest return from their limited resources can be gained by engaging the specialist and supporting his work. They have a vested interest in the success of the specialist. The greatest compulsion, however, comes from the specialist himself. He wants to succeed. Usually, he is engaged for a relatively short period of one, two, or three years, so he wants to succeed soon. The following are some suggestions for the specialist in science education in a technical cooperation project as he helps develop programs in science education.

The general thesis of these suggestions is that: *The methods for developing programs in science are general. The content of the programs as they are developed will vary greatly from place to place.* The specialist must have a *modus operandi.* He is forced to begin with the method that he knows best. It is suggested that the general method that is proving to be somewhat successful in developing science programs in this country works in other situations as well. However, the programs that are developed from the use of that method often differ greatly from the programs that have been developed here. The following are three essential aspects of that method with examples of how they were applied in our work in Afghanistan.

1. Cooperative planning is an effective method of developing programs in science education. Early in our experience, we were dismayed when some of our friends and advisers suggested that this method of work might not be practical or effective in our work with teachers and administrators in Afghanistan. To us, the method seemed essential.

Cooperative planning is difficult and taxes the patience of the impatient. All countries have had experience with programs of study and prescriptions for teaching method that

have been promulgated with high hopes but little effect. Sometimes, they are ineffectual because the people who are to implement them are in basic disagreement with the programs and prescriptions. More often, they prove ineffectual because the teachers and administrators who are to implement them do not understand or know what they mean. "He who does not understand cannot do." To have people help plan new programs and discuss suggested teaching procedures is one of the best assurances that there will be some understanding of the final product.

Perhaps, the most important argument for this method of work is that it is a means of bringing the experiences and thinking of many people to bear upon the problem of developing new programs and teaching procedures. Obviously, the experiences and thinking of teachers are needed because many of our best ideas about programs and practices are the result of day-to-day experiences in the classroom. The experiences and thinking of the administrator are needed because he has a concern for the effect of a proposal for the entire school. The experiences of the consultants are needed because they bring to the problems the results of a great deal of experience from a variety of situations. If all of these people can think and work together, the chances of success are heightened. "Many minds working and thinking together are usually more effectual than one."

Some of the science teachers of Afghanistan used this cooperative approach to develop an experimental course in general science for a new junior high school. The science teachers met regularly as an Organization of Science Teachers. Here, they expressed and discussed some of the problems they faced in their teaching. "The science that is taught in schools should be more practical." "There should be more coordination between what is taught in each of the separate subjects of chemistry, physics and biology." "Science books should be written in such a way that they can be read and understood by the students." "Science courses should be revised to include material on new and recent developments in science." "We should have a course in general science for classes seven, eight and nine."

Some of the members of the Organization of Science Teachers worked together for three weeks in a workshop to suggest the topics for a three-year sequence of general science and to outline some of the units. The sequence of topics and the outline of units were reported to the Organization of Science Teachers and discussed by them at their first meeting of the school year. During the school year, the textbook for the seventh year was written, and the units were used and tested by the general science teachers. At weekly meetings, these teachers related their experiences in teaching each topic and criticized the text materials. At a workshop the following year, the general science teachers devoted most of their efforts to developing and practicing methods for teaching the seventh year general science. The text materials were read by various officials and revised in light of a year's experiences and suggestions. The courses for the eighth and ninth years are being developed in a similar manner. This is offered as an example of cooperative planning in the development of a science program.

2. The science programs that are developed should have as a primary aim the economic development of the nation. Adequate science education is essential for the economic development of a nation. Some people must acquire high level proficiency in an area of specialization. Many more people must have a general background in science and understand the physical and biological principles involved in their work if they are to make a substantial contribution to their nation's development. It is because science education is basic to economic development that it is accorded a major role in programs of technical cooperation.

However, it is not enough to have just

any kind of science education. The science programs must be consciously developed to contribute to economic development. What are the major sources of income of the people of the nation? What are the overall plans for economic development? What skills and understandings will be needed to make these plans a success? What are the major problems that the people face as they move ahead?

We can gain an insight into the characteristics of a nation's economy from a study of United Nations Statistical Reports.[2] These facts are supplied to the United Nations by the member state. Often, this is the richest source of information of a statistical nature concerning a nation's economy that is available to a specialist. From these reports, we can learn how most people in a nation earn their living, the most important products exported and imported, the number of students enrolled in various schools and other factual information about a nation's economy. In Afghanistan, these statistics clearly point out the central importance of agriculture in the Afghan economy. The implications for science education are quite apparent.

Many nations have developed "Five Year Plans" for social and economic development. These are the authoritative statements of the social and economic goals toward which the nation is working. Sometimes, the problems can be easily inferred. The specialist in science education should be familiar with these plans because he in his work in science education should make a contribution to the attainment of these goals.

The opinions and advice of policy makers in various areas should be sought. For example, Afghanistan is known to have some mineral resources; most people who are familiar with the geology of the country predict that more mineral deposits will be discovered. A member of the Ministry of Mines and Industry explained to us how primary and secondary school teachers, with a little orientation, could help discover mineral deposits. A member of Ministry of Health pointed out the special importance of preventive medicine as contrasted to curative treatment in a country that has few doctors. He pointed out that teachers who have some understanding of sanitation and health practices can be of real service to people of the villages by helping them to prevent sickness. The specialist and his associates should seek opportunities to get the advice of people in other fields as to ways in which teachers can make a contribution to the development of their nation.

Direct observations on missions throughout the country will lead to suggestions of ways that teachers can and should contribute to economic development. What are the major natural resources of the country? Are they being utilized wisely? For example, is the topsoil being protected or wasted? What could be done to protect it? In Afghanistan, the sun which shines day after day through cloudless skies could be an important natural resource. Some day, the direct rays of the sun may become a major source of energy. Perhaps, the children of today should become aware of what is involved in utilizing solar energy? At the present time, solar energy is being used to warm homes and heat water for baths and laundry. As the technical problems involved in the utilization of solar energy are overcome, greater use may be made of energy from this source. Obviously, there are implications for science teaching. In the general science program, the science teachers included a unit on solar energy in which they explain and discuss the principles involved in the utilization of solar energy. Observations made throughout the country can lead to important insights that are helpful in developing science programs.

3. An effective program of science education deals with the problems and concerns of people. Beautifully written syllabi and courses of study and eloquent teaching

[2] United Nations. *United Nations Statistical Yearbooks.* New York: International Documents Service. Columbia University Press.

do not insure learning. For effective education, we must deal with the questions, problems and concerns of children, parents and other people in the community.

The questions that children anywhere ask seem to be limited only by the experiences they have had in their environment. "Is an electric spark the same as the spark we get when we strike two hard rocks against each other?" "How come our country has such high mountains while other countries are almost completely flat?" "Why can the camel go for such a long time without drinking water?" If given a chance, children will ask a myriad of fruitful questions such as these. The sensitive, skillful teacher works with children to help them explore such questions.

We discovered that the fathers of children with whom we met and chatted were concerned about the education of their children. For example, we asked the chiefs and elders of several villages what they would like to have their children learn in school. They mentioned many things: reading, writing, mathematics, how to grow better crops, how to weave, how to keep healthy; and they wanted their boys to learn something about electricity. We were a bit surprised because we could see no electric wires coming into the village. However, they expect to have electricity in the village in two years. They said, "We want some people in our village who understand what we can do with electricity and the dangers that are involved in handling it." The fathers of children with whom we talked were all concerned about the education of their children, and they often had fruitful ideas about the nature of that education. Not only were they willing to give their ideas, they also helped plow and level land for school gardens, build covers for open wells and repair broken classroom furniture. Parents here, as elsewhere, were a real resource for building better schools.

Although this general method of program development, which features cooperative planning and aims at economic development of the nation and personal development of young people, seems to be useful in other countries, the context of science programs developed using these procedures elsewhere often will differ markedly from programs developed in our country. When we discuss ways of heating the home, we stress systems of central heating. But these systems are expensive and really very wasteful of heat energy; in many countries of the world, central heating is completely impractical. The *sandali* is more efficient. A brazier filled with glowing charcoal is placed under a low table; a large blanket hangs down over the table, and members of the family can sit with their arms and legs under the blanket and keep comfortably warm. This method of heating is based on sound scientific principles. To fertilize our soil, we do not use clay from old mud walls. Yet, changes have taken place in this clay, as it has been exposed to the air, that produced nutrients for plant growth. The fertility of a field can be increased by spreading the remains from old buildings and walls over the surface of the soil. We often make science equipment from discarded "tin" cans. This is highly impractical in places where cans are rare and prized. These are a few examples out of the many that could be given to show that the content of science courses should differ as the natural and cultural environments differ.

SCIENCE EDUCATION IN AFGHANISTAN

Education in Afghanistan is expanding and developing rapidly. For example, in the fifteen years from 1936 to 1951 the number of children enrolled in the primary schools multiplied more than ten-fold. The needs for educated people are becoming more and more evident to everyone as ambitious plans for economic development are proposed, accepted and inaugurated. It is safe to say that in no area of education is greater expansion and development contemplated than in the various fields of sci-

ence and technology. Within the course of one year, two new institutions have been set up. One is an Institute of Education which has as its function, the education of teachers, including science teachers, at the post-secondary school level. The second institution is a University Faculty of Agriculture and Engineering. This is truly a period of dynamic change in Afghan education.

In periods of change, there is concern for education and the objectives of education. Goals for science education have been and are being suggested, discussed, debated and used to formulate courses of study, select and develop methods of teaching, write text and resource materials, and to produce and procure science equipment and learning materials. The following are some goals of science education that are frequently mentioned:

1. *The Wise Use of Natural Resources.* The natural resources of Afghanistan range from the thin soils on the peaks of the Hindu Kush Mountains to the rich, deep soils in the valleys. They include the tumultuous streams of water tumbling down the mountain sides and the parched alkali soils of desert. The mountain streams are being harnessed to produce electricity; the water is also being used to make the parched desert soils green. In Afghanistan, there are coal and trees, an abundance of sunlight and the invaluable mud from which most of the homes are built. Some of the science teachers have accepted as one of their aims to help people to learn how to conserve their natural resources and to use more effectively some of their most abundant resources.

Most primary schools have a school garden. Since many of the primary schools operate during the warm summer and are closed in the cold winter, there is an opportunity to use the school garden as a laboratory for learning. Children learn how to plant, care for and harvest crops; they conduct test plot experiments with new seeds; and they practice improved methods of cultivation and irrigation. At the teachers college, which draws students from all parts of the country, students have had a chance to see plants from various sections of Afghanistan planted, grown and used. Trees also are considered a crop, and they are often planted along the banks of the irrigation ditches that lead to the school garden. Afghan teachers are using school gardens to provide youngsters with laboratory experiences in the wise use of their soil resources.

2. *Healthy Living.* There are many problems related to health. Malaria, tuberculosis, cholera, typhus, dysentery, trachoma and other major diseases have plagued the people. Considerable progress is being made in the battle against some of these diseases. Malaria, for example, apparently has been conquered in some sections of the country. Of course, individuals can do much, if they know how, to prevent disease. To help people to live healthy lives was judged to be one of the most important goals of education by most of the teachers of science with whom I worked in Afghanistan.

Students are taught how to build sanitary wells and fly-proof latrines. In their science courses, there also are materials which will help them to learn how to convert human excreta into safe manure by composting. Some attention is given to the problem of insect control. A course in health education has been set up for teachers. Disease control and methods of preventing sickness are stressed. Teachers also are instructed in first aid and in the various ways they can safeguard the health of their children. Films on health and sanitation are shown to the people in the villages throughout the country.

3. *Improved Agriculture.* Agriculture is Afghanistan's most important source of income. Farming in Afghanistan involves many problems. On the mountainsides where dry wheat farming is done, the soil is very thin and the growing season short. In most parts of the country, the land is

arid, and great effort is required to supply water for irrigation. Locusts and other insect pests often threaten crops. Teachers can help people meet some of these problems. The children in the schools in the villages often are and will be farmers. Through their work with children, many teachers see that they can make immediate and long-range contributions to the economy of their village.

In some schools, children are learning how to raise silk worms using mulberry leaves that have been grown in the school garden. One primary school that I visited had planted their large garden to cotton. The receipts from the sale of their cotton were to be used to improve the school. This activity was especially significant because cotton was rapidly becoming one of the most important cash crops in that region. The students in the teachers college who are preparing for teaching in the primary schools devote part of their last year in the college to work in a village development program. Here, they learn such things as how to improve crop yields by selecting and cleaning good seed. They also learn to grind the discarded bones of butchered animals and to spread the powder onto the soil to supply phosphate for plant growth. Another source of fertilizer which they become aware of is the mud from walls and buildings. These students engage in this work with enthusiasm. Many of them see that these experiences will help them to be of greater service in the villages where they will teach.

4. *Skills and Understandings Needed for Economic Development.* Some of the skills and understandings needed for economic development are simple; others are complex. In a coal mine in the northern part of the country, a winch driven by a gasoline engine is used to pull the coal out of the mines. How do you start a gasoline engine? In this case, the directions for starting the engine were written in English. Someone had to be able to read and understand the directions in order to start it. A general understanding of how a gasoline engine operates and how it can be maintained is necessary in order to keep it in operation for any length of time. A comprehension of what a winch can and cannot do is necessary in order to install it. People engaged in mining, farming, or industry must master a number of such skills and understandings.

This same coal mine can be used to illustrate some of the more sophisticated understandings that are needed for economic development. Before any large mining operation can be developed, some kind of a survey should be undertaken to estimate the amount of coal or minerals that may be available and some of the difficulties that may be encountered in the development of the mine. In this region, coal is available in several strata or layers. Which strata should be opened up for mining operations? The coal is granular and cannot be used for supports in the mine. How should the tunnels be dug so that there will be adequate support to keep them from collapsing? The mines are extremely dusty. Where should the ventilation tunnels be dug? A number of skilled technicians and competent engineers must be available to deal with such problems.

The men who have responsibility for the development projects quickly recognize the need for people who have skills and understandings in science and technology. They have described these needs to science teachers and others in the field of education. A special program in geology, for example, has been set up with the assistance of the Ministry of Mines and Industry. More and more the science teachers are accepting the responsibility of helping their students to develop the skills and understandings that they will need to contribute to the economic development of their nation.

5. *Using the Products of Science and Technology.* Electricity, hybrid seed, bicycles, automobiles, and new drugs are examples of products of science and technology that are rapidly becoming more available to the people of Afghanistan. If used wisely, these products can be of great benefit. If used unwisely, they can actually do great harm. Children in the schools have

a great interest in these products, and some of their fathers have expressed their desire that children learn how to use these products. In some of the courses that have been organized for teachers, they have a chance to hook up simple electrical circuits; set up, use and maintain electric motors and gasoline engines; plant seed plots and discuss precautions to be observed in the use of new drugs. The results of this work with teachers are becoming apparent in primary and secondary school classrooms.

DEVELOPING SCIENCE EDUCATION IN THE SCHOOLS OF AFGHANISTAN

Many forces are at work in the development of science education in Afghanistan. The nation needs it, and these needs are being expressed by fathers in the villages, directors of schools, managers of industries and men of great influence in high offices of the government. Educators are planning the expansion of facilities and programs to meet these needs. The teachers of science have united to form an Organization of Science Teachers to help develop their profession.

The Organization of Science Teachers. Many of the most important schools in the country are located in the capital city, Kabul. The teachers of science in these schools have formed a professional organization. The meetings of the organization have provided a means for the teachers to state some of the problems that they face in their teaching. They have been able to work together to overcome some of these difficulties. At some of the meetings, there have been statements by officials from various departments of the government of how science teachers can contribute to their programs. Experts from fields ranging from electrical engineering to public health have discussed developments in their fields. Members of the Organization have demonstrated their methods of teaching various areas of science.

The teachers of science have undertaken and carried out a number of projects. Perhaps, of greatest importance has been planning and testing of an experimental course in general science in the junior high school. They have also had committees working on health education and the procurement and production of reference and teaching materials in science. They have suggested, criticized and tested a source book *Science Education in Afghanistan* and a seventh class general science book *Science for Richer Living.*

Their most important contribution may be that they are demonstrating how teachers can work together to improve the standards of work in their profession.

Teacher Education in Science. In one of the remote cities of northern Afghanistan, we had an opportunity to visit a remarkable classroom and observe a truly dedicated teacher. Many of the classrooms we had visited were barren and practically devoid of materials of instruction and student projects. In this room, there was an abundance of materials. There was a seed plot for growing plants. A small cage had been constructed to hold domesticated animals. Maps had been constructed out of mud, and there were various kinds of posters on the wall. There were many examples of children's projects that were underway or had been completed. The class seemed to be alive with interest. Things were happening.

It was quite evident that here was an unusual teacher who was giving a great deal to his work, including a fraction of his salary to buy materials. We tried to find out where this teacher had received his inspiration, what was his source of enthusiasm and where he had gotten his ideas. He had not had an unusual education. As far as we could determine, he had had no contact with any of the agencies at work in Afghanistan to improve education. In our superficial investigation, we could find no contributing source of this teacher's inspiration and ideas. It seemed that we had had the privilege of visiting the classroom of a teacher who was so dedicated to his work that he had searched for ways to improve

his teaching and had even been willing to devote some of his own very limited resources to make possible an improved education for his youngsters.

Why not find such dedicated teachers for every classroom in the country? In Afghanistan, as in the United States, such individuals are rare finds, and means have to be provided by which teachers can be helped to improve their teaching. In Afghanistan, this is done through an Institute of Education. The Institute of Education sponsors conferences, workshops and in-service courses. At one intensive workshop, a group of about thirty teachers of science made a study of the Helmand Valley Development Project which is the largest regional development project in the country. Their basic task was to find the ways that they, as science teachers, could contribute to this project as well as to other development projects throughout the nation. At the Winter Session of the Institute of Education, such in-service courses as "Teaching Science in the Primary Schools," "Teaching Agriculture," "Teaching Science in the Secondary Schools," and "Health Education," are offered for teachers from all parts of the country. In all such courses, an attempt is made to choose methods, materials and content that are applicable to conditions in the country. Our limited observations seem to indicate that the Afghan teachers are making an enviable record in applying the suggestions and insights they derive from these in-service courses in their teaching in the schools throughout the country.

Teacher education is of strategic importance in the struggle to improve conditions in a country. This is especially true in a country where the control of education is highly centralized, and, in Afghanistan, there was only one teachers college which had as its primary function the education of teachers. To some, it would seem to be a rather simple task to improve education under these conditions. "Develop a first-rate program in the teachers college and you will soon have a first-rate program in the schools throughout the country." Of course, this is an important step, but this teacher education must be of a practical, functional nature so that the students in the teachers college can become effective teachers in the schools to which they are assigned. They should be helped to become effective teachers of children and leaders in their villages, but they must also be accepted and respected by administrators, inspectors and their fellow teachers. It is important to develop new functional programs in the teachers college, but it is also important to work with practicing administrators, inspectors, and teachers so that they can understand and contribute to new programs of education. In Afghanistan, this is being done through workshops, conferences and demonstration schools where teachers and administrators can see new programs in action. The development of teacher education includes both the improvement of methods and programs in the teachers college and the advancement of practices in the field.

SUMMARY

These ideas and suggestions concerning *Science Education and Technical Cooperation* are based upon two years' experiences as a specialist in science education in a program of technical cooperation in Afghanistan, and limited observations in a few other countries. These experiences lead me to suggest that the methods for developing programs in science education may be general. These general methods include cooperative planning by those who are concerned with the program and its results, a recognition that science programs should contribute to the economic development of a nation, and the development of programs in science which deal with the problems and concerns of people. Although these methods of approach to developing science programs may be general, the content of the science courses that are developed will vary greatly from place to place.

SCIENCE EDUCATION IN BURMA AND THE FULBRIGHT PROGRAM *

Charles Walker Prewitt
Willimantic State Teachers College, Willimantic, Connecticut

One of the greatest needs of our times is the development of science and technology in economically underdeveloped countries in order to raise the standard of living of the people. A sound science education program for the future science teachers and scientists of these countries is a prerequisite for the establishment and continuance of scientific research and industry.

The United States through various aid plans, including the Fulbright Program, is helping various countries in developing their educational program. Through the Fulbright Program many science teachers in the United States have the opportunity to engage in one of the most challenging and rewarding experiences of their lives, i.e., teaching science or science education in an underdeveloped country. Many science teachers in the United States, however, are not sure they wish to participate in such an experience and, perhaps, some should not. The purpose of the following article is to describe science education in one country participating in the Fulbright Program, Burma, and to suggest certain criteria which one may use to help determine whether or not he desires or is suited to teach science in an underdeveloped country. It should be understood that any comment made regarding the Fulbright Program in underdeveloped countries or any suggestions given as to the qualifications of Fulbrighters are based solely on the limited experience of one nine months term in Burma as a Fulbrighter.

In going to Burma one finds a people with a long history of intense interest in education. Since achieving independence barely a decade ago, the young, inexperienced leaders of the government in Burma have been struggling against almost overwhelming obstacles, to raise the standard of living through improved education of the people. The Burmese have always valued education and could boast even in the 1800's of a population about 75% literate. The predominant religion, Hinayana or Southern Buddhism, required that all believers be able to read the Buddhist scriptures in order that each, without other aid, could acquire his own religious merit or advancement. Consequently, the yellow-robed Buddhist monks have long given each child the equivalent of a third grade education including an elementary knowledge of reading, writing, and arithmetic but little or no science was taught. The curriculum consisted largely of memorizing and reciting long passages from ancient historical and religious writings. Monastery schools of this type still provide some of the primary education especially in the rural areas. A few middle schools and high schools were established by missionaries or by the British and in 1930, as a result of pressure by the Burmese leaders, a university was started in Rangoon.

The curriculum in these schools was based largely on the European system of education and the main objective of education was to provide clerks and petty officials for the colonial government. Science and technical training in the schools were not encouraged as the role of educators in a colonial empire was to provide efficient governmental employees who could, with a minimum of trouble, oversee the governing of the people and the production and transportation of raw materials to be processed in Europe. There was no thought of educating a native populace that

* Author was Fulbright Program lecturer in Science Education and Audio-Visual Materials 1956–57 at the College of Education, University of Rangoon, Rangoon, Burma.

could provide its own scientists and engineers capable of setting up a local industry in competition with that of the ruling country.

Governmental and educational leaders of free Burma realized that an entirely new curriculum in the schools had to be provided to meet the needs of the people in an economically underdeveloped country. Consequently, since 1948 when independence was obtained, there has been a tremendous effort to provide free secular education for all from the kindergarten through the university. The curriculum and method of teaching in the new system still carries on much of the tradition of the monastic and colonial schools but sincere efforts are being made to bring about change. One of the most significant of the changes is the introduction of science into all grades of the new public elementary schools. Science is also an important part of the curriculum of the high school and the university. The leaders realize that rapid strides must be made in solving through science education some of the most pressing problems of health, industrialization, resource use and research. The following examples illustrate some of the specific problems in these areas that the educators of Burma and the science teachers from the West must consider in developing a science program that meets the needs of the people.

Physically, the children in Burma get the poorest start in life of any children in Asia yet this is a country where food of all kinds are in abundance. Superstitious beliefs of many of the mothers during pregnancy and lactation prevent her from eating little other than polished rice, and, as a result, beri-beri develops in the mother and kills the child. According to a recent unpublished report, fifty per cent of the children who die before age one succumb because the mother has beri-beri. Diseases such as dysentery, leprosy, tuberculosis, and malaria are endemic in Burma. The free medical and hospital program proposed under the welfare state concept of the present governmental leaders is hampered by a serious shortage of adequately trained doctors and nurses.

In the new infant industry, technicians, engineers and scientists are sorely needed. A pharmaceutical plant and hydro-electric project have been built and will be run largely by foreigners because of the lack of trained personnel in Burma. Some officials of the government are insisting that Burma have an atomic power plant immediately but there is not even a nuclear research laboratory at the University. Scientists must be trained in the techniques of nuclear research, reactor operation, and the use of atomic energy products before a power reactor program could be anything other than a foreign enterprise imported for show.

In research related to resource use, an Institute of Applied Research has been established by the government to inquire into the natural resources of Burma and the industrial processes necessary to exploit these resources. However, the leadership of the Institute itself and of several of the departments comes from outside Burma and local research personnel and technicians, hired after training in the local university, reveal a serious need for further training in research methods and techniques. Little laboratory research is carried on at the University of Rangoon as no graduate program is offered.

To cope with these problems in health, industry and research and to meet the need for science teachers, scientists, and a populace literate in science, an adequate science curriculum from the elementary school through the University has been planned. By national law the teaching of science is compulsory in each of the standards (grades) of the primary school, standards I-IV, and the middle school, Standards V-VII. Physics, chemistry and biology are offered as electives in the high schools. However, this planned curriculum has, as yet, several serious defi-

ciencies. The major areas in which improvement is needed in the science program of Burma are: textbooks, science equipment, and teachers.

One of the major problems in an underdeveloped country which has recently gained its independence and wishes to use its native language in the schools is the translation or writing of texts in their own language and the publishing of these in quantities great enough for an expanding educational system. Before independence, education in Burma above the primary level was largely in the English language and the textbooks were in English. Since independence a major effort has been made to provide the schools with Burmese textbooks and the populace with reading material published by the Burma Translation Society, a new institution supported in part by funds from the Ford Foundation. However, the process is slow and expensive. Pamphlet type textbooks have been written by local science teachers and supervisors. These are creditable considering the pressure that was on the writers to produce the books, however, the texts now need revising and expanding. Some very good elementary science texts in the Burmese language have been written and printed by a firm in Holland and have been introduced into Burma but little money is available for purchasing such relatively expensive books.

As to equipment, the University and the teachers colleges and some of the high schools in the larger cities have some commercial science equipment obtained from the West. Smaller high schools and elementary schools have little or no commercial equipment. There has been an attempt on the part of teachers brought in from other countries through such agencies as the Fulbright Program and UNESCO to encourage Burmese teachers and students to make inexpensive equipment for the laboratory and to adapt local materials to laboratory use. There is now a laudable effort on the part of the government education department to encourage teachers in the elementary schools in constructing and helping their children to construct simple science equipment. The chemistry laboratory in the University of Rangoon uses small charcoal braziers to heat flasks until they can afford an expensive gas plant and Bunsen burners imported from some other country. There is, however, an attitude in some schools in Burma that laboratory teaching cannot be done without standard laboratory equipment. Consequently, little laboratory work is done in these schools.

Reluctance to use improvised equipment occurs sometimes as a result of many of the teachers colleges and university professors having received part or all of their training outside of the country. Regrettably, students from underdeveloped countries do not learn how to teach science in their own country but rather how to teach in their host country, e.g., the United States, England or India. Therefore, they are at a loss as to how to teach in their own country until texts, laboratory equipment, and advanced educational facilities are provided. Added to this lack of know-how for laboratory teaching in their own country, there is a dislike on the part of professional people for working with their hands. In underdeveloped countries servant labor is cheap and even underpaid secondary and university teachers can many times afford a servent to do the manual work in the home or school. One university teacher in Burma had an intelligent assistant who had had some secondary school work. The University professor remarked that science teachers in Burma could not teach without their "peons" to handle the equipment. Science students who are educated in such an atmosphere look forward to "white collar" desk jobs and are reluctant to work in the plant or in the laboratory. Such attitudes, however, seem to be a part of other cultures as many employers of science students just out of school in the United States can attest.

As to the preparation of teachers for

teaching science in the elementary and secondary schools, Burmese educators faced with a drastic shortage of teachers have introduced emergency one year teacher training programs that fill the schools with teachers but these teachers do not have a sufficient background in science content or methods. The Burmese educators would be the first to admit the deficiencies of the program and they plan as soon as possible to improve the training of the teachers. The present teacher training program is as follows.

Primary school teachers are required to have graduated from the seventh standard and to have completed a one year course in one of the four teachers colleges for elementary school teachers. However, all graduates of the one year teachers college courses are required to return periodically for "refresher" courses until they have completed the equivalent of two years of work. All primary teachers take at least one course in science teaching in a teachers college. They teach general science in the primary grades in addition to all the other subjects.

General science in the middle school is taught on a departmentalized basis by a science specialist. This teacher has graduated from high school and has had two years in a teachers college where courses in science methods and content were taken.

The high school science teacher in physics, chemistry or biology must have studied science content at least two years in the University of Rangoon and science methods for two years in the College of Education of the University. The content courses in the University may be either chemistry, physics and methematics or chemistry, physics and biology for five days a week one hour each day. The methods courses consist of lectures and demonstrations on content and methods in the secondary school.

Science teaching in the elementary and secondary schools may be of a relatively high standard. Often, however, the courses consist only of science lectures. The laboratory sections may be limited to diagrams of equipment drawn on the board and an explanation of what would happen if the equipment were available and used by the students. At times, science teachers even read to the students directly from the textbook and they copy the words verbatim. Study often consists of memorizing the material presented in the lecture and the textbook. At the end of the year the student is evaluated by a single essay test consisting of "papers" written in answer to questions compiled by the University staff or by the government supervisors. The examinations are graded by the same persons. The local teacher has no part in the examination procedure nor in deciding whether the student passed or failed the course.

The teaching and learning situation in the teachers colleges and the University is in principle little different from that in the secondary schools. The textbooks are better and there are libraries. However, the libraries have relatively few books and these need to be used more by both students and teachers. There is more laboratory equipment on the college level than in the elementary and secondary schools and more laboratory courses are given. Much of the equipment was provided through the United States economic aid program. The lecture, note-taking, memorization, single essay test system is also found on the college level. Thus the methods of teaching science in the lower levels of the educational system are perpetuated in the college. Many students and teachers realize the whole system is inept and inadequate but see little chance of soon affecting a significant change. The reason most often given for not changing the curriculum is that the teachers must teach the students the material that is likely to be on the national examinations. The students complain they must learn (memorize) the material in order to pass the examinations.

As might be expected, this system

produces scientists no better equipped to work in laboratories than are teachers prepared to teach science. The average Burmese trained locally in science is able to do little in the laboratory or in an industrial plant. There are notable exceptions of teachers who in spite of their previous educational experiences are trying to introduce new concepts of science teaching and study. There are also some scientists who can work in the laboratories and who have won international recognition for their work. For example, at an international conference on utilization of solar energy, the solar cooker designed in Burma won commendation as the cheapest, efficient cooker designed.

What is the possibility that the present system of science education in Burma will be altered so that the science students can acquire the knowledge, attitude, and techniques necessary to become productive scientist and science teachers? Burmese educators and scientists have done much already and would in time develop on their own a much improved science education program.

The objective of the United States aid program is to share with the Burmese some of the learnings made in the West over relatively long periods of time, and, hence, help them to avoid making some of the mistakes the Western countries made in developing their own science programs. Yet some of the specialists from the United States who go to underdeveloped countries under the aegis of an aid program come back feeling that they accomplished little if anything. Can Western experts go to another country, a different culture, and in a year or two actually be of assistance to the people in improving their own science program? Are the monies spent for such an objective wasted or, worse, are the friendship and mutual respect which should ensue from such relationships replaced by loss of prestige and respect due to failure of the program? Answers to these questions, of course, vary from country to country and person to person.

The success of any foreign aid program in education depends almost completely on the personnel responsible for the teaching and administration. Regardless of the attitude of and the situation in the host country, the Fulbrighter should make the adjustments in his own thinking and instruction so that the attitudes towards the United States and towards an improved science education program are more positive than when he arrived. Of course, it is not possible to be successful in every situation but the ultimate responsibility for success or failure rests with the Fulbrighter regardless of the situation. He should not blame his hosts for not arbitrarily changing their position at his request. It is assumed that the Fulbrighter will achieve positive results, if not in teaching then in personal relations. What then are the conditions one will find in Burma and what attitudes and characteristics aid the Fulbrighter in having a successful and rewarding experience.

As to conditions, first, the Burmese always suspect that a Westerner, particularly a white Westerner, has come over with a superior attitude and plans to carry on the tradition of telling them what to do and how to do it because only a short decade ago the Burmese people were subjects of the British. The Burmese are proud of their country and their own heritage and resent any implication that they are inferior or unequal in any way. Second, they are basically an easy going people who pursue their activities leisurely. They do not understand the aggressive, over-industrious Westerner who tries to push them to work harder or longer. Third, the Burmese realize that changes should be made in their science program, but as all other humans, resist personal change. Always defensive excuses are given such as: the equipment is inadequate, or no laboratory is available, or the administrator is in error, or the nationwide examination . . ., or the Ministry of Education . . ., etc. Fourth, the class-

room facilities, equipment and books are inadequate and improvisation is the rule. Fifth, the general living conditions for the Fulbrighter and his family do not conform to Western standards.

One should expect inconvenience and discomforts in an underdeveloped country but there is also the possibility of illness, malnutrition, and lack of adequate medical care. If one is stationed in a major city such as Rangoon good medical facilities are available and the dangers to health are less. The more remote areas of the country provide relatively less medical care and more dangers. None of the fourteen Fulbrighters and their families became seriously ill during their stay in Burma in 1955–56 but several suffered from various stages of malnutrition and minor diseases.

Finally the economic aspects of traveling to and living in the host country under the Fulbright Program is an important consideration. Transportation is paid to and from the host country for the person receiving the grant. Also, a salary adequate to meet expenses is paid in the currency of the host country. However, a Fulbrighter who takes his family with him must pay all traveling expenses for his family and should plan to pay these expenses himself over and above any money that he will receive from the Fulbright Foundation. There are, incidentally, programs such as the International Cooperation Administration (Point Four) which provide more funds for travel and generally a better salary.

As to the characteristics necessary to ensure the potential Fulbrighter a minimum of success and satisfaction in his assignment, the following are suggested. First, the person should honestly believe that no human is inferior because of his color, race, religion, present cultural or physical environment or past history. The Westerner should be able to treat any person he meets as an equal and worthy of respect as a human being. He should sincerely want to be friendly and should be ready to take the initiative in establishing a friendship. Second, one must understand and accept cultural traits different from his own. Ways of learning and working which apparently prevent the Westerner from achieving his most cherished aims must be accepted and other means found to reach the desired ends. The person must be flexible enough to develop methods of working successfully within the cultural environment in which he is placed without antagonizing his hosts. Third, the Fulbrighter needs to have a sufficient understanding of the way people learn and react so that he can discern characteristic attitudes and reactions of individuals in various learning situations even though the reactions are veiled by cultural differences and politeness. For example, the universal reaction of defensiveness on the part of the person asked to change must be recognized as such by the Westerner in order that he himself will not become resentful at seeming obstinacy. He should be able, without becoming defensive, to accept questions relative to the merit of his own methods. Fourth, the Fulbrighter should be truly willing, even eager, to learn from his hosts. The Westerner can learn much from his Eastern hosts. For example, he can learn about their relaxed way of living, their enjoyment of friends and family, and their attention to the spiritual as well as to the material. Fifth, the worker in an underdeveloped country should be willing to provide his own books and educational resources and be ready to work with what local materials are available even when there is no laboratory or equipment, and no ability on the part of the host institution to provide these. Such simple materials as insulated wire may require an afternoon of searching in the local bazaars. One may even have to secure some needed items from a distant city or another country. Sixth, one should be willing to live and to take his family to live where health conditions are substandard. Of course, he should

first determine, if possible, whether the risks inherent are worth taking. The Fulbrighter's family should accompany him both for the additional contacts provided in the host country and for the insights the local people gain into the American family. Also the Fulbrighter and his family should be much happier together in a foreign country than separated. If circumstances are such in the family that congenial relations among members of the family are not already present, one should never go to work in an underdeveloped country hoping that the adventure will improve matters. On the contrary, the additional strains and tensions of living and working in a foreign country will magnify any existent problems.

Finally, one must be able to take the long view regarding change in an area where one feels so much needs to change and change rapidly. People in our own country, we ourselves, actually change slowly when fundamental attitudes are involved. Little may happen in one Fulbrighter's stay in a foreign country but the effect is accumulative and many working over a period of time will produce beneficial results both in education and in human relations if each contributes a little.

Traveling and working in a foreign country, learning new ways, meeting and working together with culturally different people for the mutual benefit of all can be one of the most exciting, stimulating and rewarding experiences available to a teacher. If so, the only regrets one will have is that his period of service was so short. His constant hope will be that he can soon travel, teach, and learn again in a culture different from his own.

EDUCATION IN BURMA: NO BLACKBOARD JUNGLE *

FRANK E. WOLF
State Teachers College, Fitchburg, Massachusetts

INTRODUCTION

THE very antithesis of teaching conditions, as reflected by pupil-teacher relations in the *Blackboard Jungle,* obtains in Burma. Parents teach children to respect teachers with considerable success. This is partly due to the mutual respect between parents and children, and partly due to general respect exhibited toward their monks who were, until recently, the fountainhead of Burmese education.

At the time the writer was in Burma insurgent activity made travel, except by air, dangerous. As part of his orientation to Burma, the writer was told that if molested by dacoits or insurgents, he was to tell them that he was a teacher. The *saya* might make a small "voluntary" contribution to the gangsters, but even they respected a teacher and would not deprive one of his possessions.

With this background of understanding the respect for teachers in general, one may examine Burmese education, and the science program in particular, more closely.

TABLE OF ORGANIZATION

Burmese education is centrally controlled from the capital city of Rangoon and administered through seven educational divisions as follows:

Rangoon: Parliament
  Minister of Education
    Minister's consultant } form policy
    Minister's secretary }
    Director of Public Instruction—carries out policy
    Assistant Directors of Public Instruction

* Based on author's observations as Fulbright Teacher in Burma. Based at Bassein, Burma (150 miles from Rangoon) as supervisor of science for Irrawaddy Educational Division, one of seven such divisions in Burma.

Inspector of Schools for Science
Inspector of Schools for Social Studies
Inspector of Schools for English
Additional Inspectors for other subjects

Divisional Headquarters:
Divisional Inspector of Schools
Deputy Inspectors of Schools
Headmasters
Teachers

The divisional officers do not supervise the State Teachers Training Institutes; these are controlled directly from Rangoon by the Director of Teacher Training. Science education is likewise centrally controlled from Rangoon by the Inspector of Schools for Science; curriculum revisions and their evaluation take place in Rangoon.

Except for the elementary schools, little provision is made for the unique needs of vastly contrasting district communities.

BASIC PRINCIPLES

The guiding philosophy of Burmese education is expressed in the *Education Plan for a Welfare State* as "Five Main Principles."

1. To ensure that all citizens of the Union shall have a basic education in reading, writing, and arithmetic.
2. To ensure that a sufficient number of technicians and technologists shall be produced.
3. To train young people to perform their duties as citizens of the Union.
4. To produce men and women who possess the Five Strengths (moral, physical, social, economic, and intellectual).
5. To perpetuate democracy within the Union.

THE TEACHERS' CONDITIONS

Schools are generally overcrowded and understaffed. Free public elementary and high school education, as well as adult mass education, are post-Independence (1948) innovations. Prior to Independence, village children received their education in the three R's from monks. Science was not taught. Town and city children went to mission schools or the few government-supported schools. Many children had no education beyond the monestery school. Thus there were few trained indigenous persons to assume the teaching of all the children in the newly established government schools.

Today's teacher in Burma has a schedule of thirty weekly class periods. General science and a high school pre-medical program, both newly introduced, call for teachers in some district towns to work seven days each week with a full class load in order to train as many future medical students as possible in the shortest reasonable time.

The financially harassed Western teacher has a counterpart in his Burmese co-worker. As a high school teacher, his salary will be $30 to $40 a month; a high school headmaster would receive $50.00; a professor at the University of Rangoon might earn as much as $200.00; while elementary teachers receive $14 to $22 and elementary headmasters $18.00 to $26.00 monthly. This is in contrast with a monthly salary of $15.00 for a gardner and $18.00 for a cook. However, maximum salaries are reached in five years, a cost of living allowance is given, and many teachers offer private tutoring.

Promotions are based on a combination of factors, including length of service, teachers' formal qualifications, and merit. Holidays are numerous in addition to two summer months vacation and ten days casual leave. This tends to confuse or brighten the issue, depending upon whether one is a teacher (earning this "time off"), or a local citizen.

TEACHER TRAINING

To alleviate the acute shortage of trained elementary teachers, state teacher training institutes have been organized in the main towns. Pre-service teachers may take the two full years of training offered, or may take one accelerated year, teach, and return for summer sessions. Special two months summer courses have been instituted to provide an immediate supply of teachers with the barest essential preparation, and

to provide refresher courses for experienced teachers.

In addition to the state teacher training institutes, there are four year liberal arts colleges in Rangoon, Mandalay, and Moulmein which have faculties (schools) of education. Graduates from the faculty of education receive the bachelor of education degree and will probably become high school or pre-medical teachers. Two further years of study will gain the ambitious a master of education degree.

Prior to World War II there was practically no science taught in Burma outside of Rangoon. In 1949 there were practically no trained science teachers. And in 1951 practically no science equipment existed in that nation. One observer wrote, during the 1951–52 school year, that science instruction was largely a matter of chalk and talk.

The state teacher training institutes were, in 1953–54, beginning to give instruction in elementary science. However, the instructions were not satisfactory because they did not provide the teachers in training with the opportunity to work with science equipment. Lectures were given and the students saw demonstrations, but did not perform these themselves. The instructors frequently had not previously performed the demonstrations they were performing for the teachers in training.

Even in the liberal arts college, science graduates were receiving degrees without having any more experience with science laboratories than seeing the professor perform demonstrations. These conditions have been recognized as undesirable and steps have been taken to provide laboratory periods as well as demonstration periods, along with lectures.

During 1953–54, tremendous quantities of science apparatus were being distributed to the state high schools. The high school pre-medical programs were being stocked with, among other things, analytical balances and microscopes, one per student. And the general science programs were receiving apparatus for demonstrating every possible suitable principle. The supplies were considerably more elaborate than those in several United States high schools in which the writer has taught.

THE SCIENCE PROGRAM

Primary science (standards one through seven) was rudimentary, with emphasis on learning abstract principles. There were few teachers trained in elementary science and few trained teachers in the colleges qualified to give teachers in training instruction in elementary science. The quality and extent of the program was, in this writer's opinion, largely determined by the personality of the individual teacher.

One teacher who had had no science training was performing wonderfully well with large classes. She performed the demonstrations over and over on her limited free time until she could perform them for her students. She actively sought help from government sources such as pamphlets and brochures, as well as from a local United States Fulbright teacher. She also sought information from the United States directly.

Across the nation another teacher was teaching general science in both English and Burmese, although the requirement stipulated Burmese only. She was doing a magnificent job while disgruntled co-workers could not find time (in some cases with half the work load) to do a satisfactory job in Burmese alone.

Post-Primary science, in standards eight and nine, also varied according to the teacher and the geographical relation of the high school to the pre-medical program. Before describing the post primary program, it is necessary to explain the grades in Burma. Standards one through seven are primary and middle school, roughly equivalent to our elementary and junior high school. Standards eight and nine are post primary or high school and stand in place of our grades nine through twelve.

There are at least four pre-medical high

schools in Burma. To these schools, are assigned three teachers, one each in biology, chemistry, and physics, and a more than generous supply of science equipment. Selected students are given two years of each of these three sciences, which must be taught in English, plus advanced mathematics. This program is in addition to their normal high school program. In this way, two years are saved on the college pre-medical programs.

Eighth and ninth standard general science is usually taught by a single teacher who, at best, is a recent graduate with neither teacher training nor teaching experience. High schools with pre-medical programs are considerably better equipped than others.

Eighth and ninth standard general science is conceived as a stringing together of biology, chemistry and physics. It is not taught, for example, as an exploration into the way man uses machines, but rather as an exercise in memorizing the kinds of levers and machines and (usually Western) examples of each are given without regard to student familiarity with these or the relation they may have to the lives of the children.

Similarly, botany in the pre-medical biology course is concerned with memorization of leaf venation and not with a method for beautifying the school compound, although this was a concern of the students with whom the writer worked. Insect and rodent control in an area where plague is prevalent are not considerations of the pre-medical program.

There is little relation between the curriculum and some of the needs of the community, as expressed in student essays written for the author. For example, kinds of bacteria are studied, but the effect of spitting on tuberculosis transmission is not considered. Abstract principles of water purification are not related to the classroom water jug into which students plunge their hands and a cooperative cup—after avoiding the use of hankerchiefs in situations where one would use them.

The bright side of the coin is that the Director of Public Instruction and his staff are exceedingly competent, sensitive, modern, and well educated men. They are aware of the shortcomings and are taking steps to overcome them. For a nation only eight years old, great strides have been made and will continue to be made to bring science education up to mid-twentieth century.

THE STUDENT

Students attend classes from June 1 to March 31. State primary and post primary schools are free, attendance is required. (Although ninety per cent of the students would attend without compulsion). Children in the schools are not segregated according to sex or other criteria.

There is little student participation in classes although attempts are being made to introduce newer methods of teaching to replace the lecture-demonstration method. The lack of participation is due to the belief that students are too bashful to respond in class. Yet in Moulmein, the writer saw some excellent class participation conducted both by a Fulbright teacher and a Burmese general science teacher.

The writer found through his own experience with Burmese post-primary students and in-service training groups of indigènous elementary teachers in Bassein, that in less than six weeks for children, and two to three weeks for adults, lively group discussion can be stimulated.

Students are tremendously aware of social issues and expect the school to help solve social problems. Student strikes for better conditions as well as for support of favored teachers transferred to other areas are not uncommon. The Burmese students with whom the writer was privileged to work showed in their papers that they were conscious of community problems and quite willing to bring problems to the school for solution.

Unfortunately, 1953 Burmese students

were subject to the effects of one hundred twenty-five years of British rule. Their teachers, for the most part, were unaware that there were objectives of Burmese education beyond the acquisition of isolated facts and definitions. Practical laboratory periods were well liked by the students, but high impractical, suffering from cultural lagitis and unable to help the children solve their problems.

BOOKS AND AUDIO-VISUAL-AIDS

The greatest shortages are in books and audio-visual aid materials. However, the United States Information Service Library in Rangoon supplies books by request, and Fulbright teachers are introducing the districts to the proper use of this splendid library. The USIS will also supply, on loan, kerosene projectors and films for high school use.

Most science books in Burma are in English and unsuitable for post-World War II children who do not read English well enough to use them—aside from their shortage. However, the Burmese Translation Society is in the process of preparing suitable materials. There is also the problem of a lack of Burmese science vocabulary. For instance, the word for moving picture projector in Burmese is *bine scoe,* after the British, bioscope. In 1953–54 science books were limited to the copy owned by the teacher.

The Burmese are quite aware of the inadequacy of their science program. Efforts are being made to provide trained teachers and equipment. Two years ago there were few trained teachers on the elementary level who were capable of providing science instruction, and almost no equipment.

The program on the elementary level was handicapped by the inability to capitalize on two concepts: one, to share equipment with the well equipped state high schools; two, to improvise demonstrations from locally available materials. For example, in a village elementary school near Mandalay, the writer was asked to lecture on science. He inquired what the children and teachers would be interested to hear. The principal replied, "Oh, anything you care to talk about will be of interest." It was felt that a lecture for the sake of talking would be wasted. The principal opened a closet to show the extent of science equipment in his school. There were spools of rubber tubing, some funnels, glassware, and little else. He asked the writer how his teachers could demonstrate some principles of sound and it was possible to show how to combine the funnel and tubing in the process of making a stethoscope, as one example.

CONCLUSION

If there were only one generalization to be made concerning the teachers of the United States and those of the Union of Burma, it would be this: devoted teachers in both countries will do a good job regardless of obstacles; shortages, problems, and frustrations do not deter the teacher who cannot give less than the best that is in him. Similarly, for those who will not do a good job, excuses are always readily available.

There is an ancient Burmese proverb which serves to illustrate the differences between individuals within each culture; freely translated it is: If one wants to get something done, ask a busy person to do it.

SCIENCE TEACHING IN GERMAN SECONDARY SCHOOLS

ERWIN A. BAURMANN *

66 Danzger Str., Karlsruche (17a), Germany

"IT is the aim of the Secondary School [Grammar School, Gymnasium] to educate the youth through knowledges and the development of the individual character to be ready for life, and to prepare the youth for its studies at the universities. This education of young people will be done in encountering the cultural traditions of the Occidental Christian World" ("kulus und Unterricht" 6, (3a), 7, 1957). These statements are from the preface of the new outlines of curriculum and courses of studies for the State of Baden-Wuerttemberg in the Federal Republic of Germany.

Secondary education is intended to be for a large but selected number of intelligent pupils. It should develop an advanced understanding of and meet the curiosity about the world in which we live. This includes religion, literature, history, languages, arts, mathematics, and science. It intends to develop in the individual person, his character, a critical mind and a trained brain able to think, and to cultivate leadership as an active and creative part for modern life. Emphasis is given to advance and promote the most able and best young members of society.

We do not believe in any type of specialization before the age of about 20 years when the studies at the university start. So science in school is a subject among others in the wide field of a general education.

After four years of Elementary School, children will be selected for the attendance at a Grammar School through examination. All subjects except a very few are compulsory. At the end of each year records and grades achieved will decide on the promotion to the next class. Failure in two major subjects (sometimes even in one, if not more than average ability in other major subjects can be shown) will cause retention. This system provides a permanent means of selection in favour of the more intelligent and also provides a fairly similar ability throughout each class. At the end of the 13th grade a final examination (Abitur) in five major subjects has to be taken, the certificate of which allows studies at any German university.

There is no course in General Science in the curriculum. Biology and Geography are taught from the 5th through the 13th grade with normally 2 lessons per week for each subject; Mathematics (arithmetic plus geometry through to calculus) with 4–5 lessons (in some classes of the language-type gymnasium only 3) per week. Physics is offered with 2–3 lessons starting at the 9th grade and Chemistry with 2 lessons starting with the 10th grade. In addition to this, extra laboratory work is available but not as compulsory subject.

The main aim of the first two years in physics and chemistry covering the basics of mechanics, heat, acoustics, optics and electricity in the field of physics and air, water, oxygen, hydrogen, the halogens as an example of a family of elements, sulfur, nitrogen (NH_3 and HNO_3), phosphorus (with H_3PO_4), carbon, coal, oil and simple organic compounds in the field of chemistry is to meet the curiosity about nature and to develop the basic ideas and conceptions in chemistry. The methods of actual scientific research should be the methodic model of all instruction in this field. It should always be characterized by the permanent mutual interaction of thought and experimental experience. So in the upper grades of science instruction, where the whole course is reviewed on a higher level and extended into the theory of waves and the basic facts of atomic physics, to metals, general chemical rules, energy relations, ion theory, radioactivity and the periodic system

* Grantee of the Teacher Development Program administered by the U.S. Office of Education in cooperation with the U.S. Department of State.

in the field of chemistry, the lessons become more and more academic, using more mathematics than just simple algebra and introducing deductive methods.

At some schools, even today, science still is taught in a too systematic manner, emphasising knowledge without true understanding. But there is a strong tendency towards less emphasis on facts per se and using the spare time gained to develop scientific thinking. WAGENSCHEIN suggests to jump in at any point of the tower of science, following the curiosity about the world around us, and from such an "entrance" to widen the circles gaining *knowledge* and *understanding* as well. Teaching through characteristic examples instead of "covering the ground" is the newer emphasis. Therefore the new course of studies of the State of Baden-Wuerttemberg places less emphasis on facts in science and more emphasis on material to train the mind in the ability to think and to understand. It leaves a great deal of freedom to the teacher in the selection of teaching methods and materials so as to better adjust to the local situation. On the other hand it assures a similar level of science teaching throughout the state, and by general agreements among the federal states, also throughout the whole country.

Compared with the United States and Great Britain, the German Secondary Schools do not make enough effort to encourage and to educate the students to the use of books and libraries for their own studies in the field of science. Though all lessons normally are going on as a permanent discussion between the teacher and the students, the instructor still gives too many facts himself. This is partly because all the more precise experiments have to be conducted as demonstrations rather than being done by the pupils themselves in the form of laboratory work. Though the supplies in biology, physics, and chemistry are fairly adequate, there is not yet enough equipment nor room available to use laboratory work in the compulsory courses of studies.

Laboratory work is done in so called "Arbeitsgemeinschaften" (working groups) on a voluntary basis. This is not intended to be an extension of the regular course in that particular subject but it is a self contained work of its own. Free as well as instruction type experiments are carried out by the students under the supervision of a teacher. Instruction type experiments do not mean "cook-book" style. The theory involved should always be carefully studied and discussed first.

Most of the more modern equipment in physics and chemistry is of the multipurpose, "build together" type made available by German firms specialized in science demonstration and laboratory instruments (Phywe, Goettingen; Leybold, Cologne; and others). Aid to the extent of 12,000 marks has been promised to the physics department of every German Gymnasium by the Secretary of Atomic Energy of the Gorman Federal Republic to improve scientific equipment and to promote science instruction. The normal budget provided every year by the community is still too low to meet all needs in science education.

Up to the date, no laboratory assistants are available as it is the rule in Great Britain (M. J. McKibben, *The Science Teacher,* 25, 138, 1958). At the German School, the science teacher still has to do all manual work involved with science lessons, demonstrations, and laboratory work. Though he finds the helpful hands of more eager and interested students available, he mostly uses this extra time spent in the science rooms more to the benefit of the students than as an actual help.

Good slides and films of instructive value are available in all science subjects through the "Landesbildstellen" (State Audio Visual Aid Departments) with subdivisions in all larger cities. The necessary equipment for display—projectors, movie apparatus, tape recorders and radios—is normally in the possession of the school, if not it will be loaned for an unlimited time.

Since in most cases there are four parallel classes of the same grade every year, the science teachers concerned have to reach an agreement with each other on the order of items and the course of studies to be followed in particular to avoid conflicts in the use of science equipment. To provide a more coordinated and integrated type of education in every class, the instructor for mathematics and physics as well as the instructor for chemistry and biology will be the same person wherever that is possible. Many times even three subjects in science will be taught by the same teacher. In mathematics normally eight written tests are requested for grading beside oral examinations. In science written tests are not required but allowed. The teachers use their right to have short oral examinations for grading at any time they desire during a period.

The final examination (Abitur) in science at the end of the 13th grade is based on specific information plus their philosophical and historical backgrounds, general principles of nature and quizzes; oftentimes experiments will be shown which the candidate has to explain or to evaluate.

The minimum requirements for the training of science teachers after graduation from the 13th grade in Gymnasium are 4 to 5 years of special studies in the chosen fields at a university, First Examination hereon plus 2 years of a Teachers Training Seminar (methods of teaching and education) and the Second Examination hereon. There are many teachers having more training in science than the minimum requirements. About 10 per cent of the instructors hold the Ph.D. and more than 10 per cent the equivalent of the Masters Degree (Diploma).

ON THE STATE OF PHYSICS TEACHING IN THE RUSSIAN REPUBLIC *[1]

G. P. EVRONIN
Moscow

TRANSLATOR'S NOTE

SPUTNIK, academic tourism, and inadequate research here in America, combined with the current predilection to stand in awe of Soviet achievements, have led to an uncritical acceptance of the superiority of physics teaching in the Soviet Union. But, as much as one may be surprised, this high regard is not shared by Soviet teachers and authorities. *Why* is no secret, as the Soviet pedagogical press will reveal if only patiently consulted.

The translation which follows is a lengthy excerpt (pp. 45–48) from an article which explains in part Soviet disgruntlement with the usual teaching of physics and state of affairs therein. There is a tendency for Americans, impressed by Soviet education and viewing things Soviet in the American image, to shrug oft material such as that translated below as somehow atypical. But cognizance with Soviet press practice rules out such rationalization. In the Soviet Union the negatively atypical about the Soviet scene is rarely published in the pedagogical press or elsewhere for that matter. So-called atypical articles point to real conditions, real problems, and set the stage for proposed or decreed solutions. Anyone, seeing these "atypical" articles over a period of time can almost predict authoritative action with respect to their content. Thus, it should come as no surprise that on July 31, 1958 E. I. Afanasenko, Minister of Education for the Russian Republic, issued decree

* Translated by Ivan D. London, Department of Psychology, Brooklyn College, Brooklyn, New York.

[1] *Fizika v Shkole, Physics in the School,* 1958, 18, No. 6, 43–49.

No. 254: "On the State of Physics Teaching and of Knowledge of Physics in the Schools of the Russian Republic and on Measures for Their Improvement." The decree is the natural sequel of previously expressed dissatisfaction *allowed* and *solicited* in the Soviet pedagogical press.

Translation

. . . The fine qualities in the teaching of physics, alluded to above, are, however, far from standard in all schools. On the basis of classroom observations, testing, and the examinations for the graduation certificate of maturity in a number of Moscow schools in 1958, it is possible to conclude that the actual knowledge of physics possessed by the students in these schools is less than their grades would lead one to suppose—grades, now on record, on the basis of which the last quarterly and annual grades will be calculated. Higher educational institutions, in view of performance in the 1957 entrance examinations, likewise affirm the existence of deficiencies in the knowledge of physics among many students. Thus, the Moscow Institute of Fine Chemical Technology announced that there are high school graduates with no lower than "four's" and "fives's" [good and excellent, respectively] on their graduaation certificate who received lower grades in their entrance examinations. Only 19.6 per cent of the examinees received "five," 42.9 per cent "four," 29.3 per cent "three," and 8.4 per cent "two" [unsatisfactory]. The Moscow Aviation Institute and other higher educational institutions observed that even pupils who had been awarded medals, in individual cases, received unsatisfactory physics grades in the conferences and examinations. Along with this one should note that in a number of higher educational institutions (Leningrad Mining Institute, Moscow Textile Institute) the percentage of high school graduates who received "five" in the 1957 entrance examinations increased somewhat in comparison with outcomes in 1956.

In order to ascertain the knowledge of material studied in the first and third quarters of the ninth and tenth grades for the 1957–58 school year, a testing program was carried out by the Main Administration of Schools in 15 schools in three cities in Kemerovsk Province (Kemerovo, Stalinsk, and Prokop'evsk) and in ten schools in Arkhangel'sk.

One cannot acknowledge the results of this testing program as satisfactory. Of the ninth grade students in Kemerovsk provincial schools who took the written examinations, 25.5 per cent received unsatisfactory grades, in Arkhangel'sk schools 26.2 per cent. In the tenth grade these figures become 20.5 per cent and 29.3 per cent respectively. Several students with quarterly grades of "four" and "five" could not even handle the tests.

Many ninth and tenth grade students were unable to provide general solutions to problems, draw electric circuit diagrams, or transform units of measurement of physical magnitudes.

The retention of learned material, studied chiefly in the preceding grade, was also checked in the schools of Penzensk Province by the Institute of Teaching Methods of the Academy of Pedagogical Sciences. More than 2,000 ninth and tenth grade students were tested. The examination results were even worse than in Kemerovsk Province and in Arkhangel'sk.

The poor knowledge of physics displayed by a considerable segment of the ninth and tenth grade students is largely traceable to the low quality of the teachers' lessons. The chief defects of these lessons are improperly planned use of class time and superficial explanation of new material. Entirely too much time is sometimes spent on the recitation of individual pupils. Thus, for example, Parilova, a teacher in school No. 74 in Novosibirsk, devoted 30 minutes to the questioning of two pupils and the solution of a problem. Accordingly, in the course of her lesson she managed to go over only one paragraph in the textbook,

leaving four unexplained paragraphs as an assignment for homework to her students.

A study of time apportionment in the physics classrooms of Moscow schools was conducted in 1957 by the Physics Methods Laboratory of the Academy of Pedagogical Sciences' Institute of Teaching Methods. In the resulting analysis it was noted that various teachers spent little or no time in explaining homework assignments. In 30 per cent of the periods studied, the teacher gave the homework assignment after the bell had rung. This is intolerable since it leads to making homework unnecessarily hard for students.

Many teachers conduct their classroom experiments on a low level. In many instances experiments required by the teaching program are not demonstrated. Thus, Sineokaia, a teacher in school No. 34 in Kemerovo, presented no experiments as the class studied the law of Boyle and Mariotte, although the equipment for them was available. Teachers often carry out only the simplest experiments, utilizing manufactured apparatus that do not require special handling, and bypass experiments which require preliminary preparation and checking.

For the most part no drill in material explained by the teacher during the lesson is conducted.

Problem solving is of great value in the teaching of physics, but there are teachers who misuse this activity and make of it a goal in itself, as they try to run through the solutions of all problems listed in the physics exercise book. Teachers frequently pay great attention to carrying out computational operations and fail to explain the physical meaning of a problem.

When it comes to problem solving, students are frequently not encouraged to go at it on their own. Frequently, all they do is copy into their notebooks what is written on the board, at times even repeating mistakes committed there.

Student recitation and problem solving are, as a rule, conducted apart from experiment. Of twenty-two teachers in Kemerovsk Province only one teacher—V. R. Gaus of school No. 2 in Prokop'evsk—required experimental demonstration to accompany student recitation, for example, to illustrate a student's account of the subject of "self-induction."

When teachers question their students, attention is most often of all concentrated on questions of a formal character (formulations of laws, definitions of physical phenomena, magnitudes and units of measurement of these magnitudes) with little attempt on the part of teachers to develop in their students the ability to explain functional relationships between phenomena and to do so on the basis of general physical theories or to discern connections between material under study and material earlier studied. Since key questions from previously studied material are not considered by way of review, this material is forgotten and the stability of what has been learned rendered uncertain.

During individual student recitation the class usually idles. Students have not been taught to attend to what is going on; they are not called upon to correct answers to questions or to supplement them with remarks of their own.

The low quality of the lesson results in making homework too hard for students. In individual cases this arises as a consequence of an unskillful exposition, going into superfluous detail, of official program material. Cases of unauthorized expansion of the course program are observed.

Too great a burden is put on tenth grade students because of a practice frequently pursued by a number of teachers—that of systematically reviewing everything previously studied in the eighth and ninth grades in the same volume and sequence as learned originally.

Overloading tenth grade students is sometimes increased by the absence of organic connection between the teaching of courses in physics and electrotechnique that results when, contrary to the directives

of the Russian Republic Ministry of Education, these subjects are taught by different teachers.

Laboratory work in connection with the study of new material has not yet been introduced into the practice of several schools. In visits to twenty-one schools in the cities of Kemerovo, Prokop'evsk, and Stalinsk it was established that, instead of the 525 laboratory activities prescribed for the sixth to tenth grades of these schools, there were in fact only 280. There are schools in which laboratory work is almost altogether absent. In school No. 42 in Kemerovo twenty-seven demonstrations out of the prescribed twenty-nine were not undertaken, in school No. 70 twenty-four out of twenty-six.

In the majority of the schools undergoing check, the essential equipment for the experimental demonstrations was there, so that it should have been possible to turn out substitutes for missing apparatus in the school workshops.

In several schools laboratory work lags behind the teaching schedule. Thus, Voronova, a teacher in school No. 4 in Prokop'evsk, conducted laboratory work on the determination of the specific heat of a substance after completion of the topic "Heat and Work." Similar facts point to the absence of necessary control of the organization of physics teaching on the part of many school directors and organs of popular education.

The mediocre quality of teaching in physics and the low level of knowledge displayed by students are in many ways due to inadequate furnishing of physics rooms with demonstration and laboratory equipment. In spite of the fact that every year the Main Administration of the Technical-Educational Aids Industry turns out from 1,500 to 10,000 instruments of each kind, designated for experimental demonstrations, and from 30,000 to 70,000 pieces of laboratory equipment, the needs of schools are, nevertheless, not fully satisfied.

Several schools increase the amount of equipment in the physics rooms with apparatus, made by students as part of their club activities. The best pieces of apparatus made by students are put on display in provincial exhibitions. Thus, pieces of apparatus from 31 schools were presented to an exhibition, organized in March, 1958 in Smolensk. Similar exhibitions took place in Omsk, Tul, Voronezh, and elsewhere. In Kemerovo a permanent exhibition, called the "School Polytechnical Museum," was set up, displaying apparatus made by students. However, in many schools homemade apparatus is made neither in physics clubs, nor in the school workshops. This is partly explained by the lack of technical handbooks on making homemade apparatus, but, as a rule, the basic reason is lack of teacher initiative and also indifference on the part of the schools' leadership.

The proper organization of physics teaching is rendered difficult in schools not having physics rooms. Altogether 19 per cent of the schools in the Russian Republic are like that.

In many schools, including those having separate physics rooms, the maintenance of apparatus is not satisfactorily handled, for example, in school No. 2 in Prokop'evsk (Director A. P. Kobzeva) . . . and in school No. 4 of Kemerovo (Director E. G. Ginzburg).

In these schools pieces of apparatus in good repair are not, as a rule, separated from those out of commission; on the same shelf all kinds of devices are mixed up.

During recent years the use of motion pictures and slides has been introduced increasingly into the teaching of physics. Unfortunately, the majority of schools do not yet have permanent projection equipment in their apparatus rooms.[2]

It should be noted that the low quality of knowledge in physics is due also to deficiencies to be found in the text and exercise books in use for the eighth to tenth grades. The book by L. S. Dmitriev

[2] This paragraph is an insert from p. 44.

et al. *Physics Lessons in the Eighth to Tenth Grades,* methodological expositions placed in the journal *Physics in the School,* and also methodological handbooks, issued by the State School and Pedagogical Literature Publishing House and the Academy of Pedagogical Sciences, can be of some assistance to teachers in overcoming these deficiencies.

The weak knowledge of physics with which our students graduate should disturb everyone. In the 1958–59 school year the teachers and leadership of the schools and of the organs of popular education shall have to strive for a radical change to the better in the teaching of physics and for a rise in the level of knowledge in this subject.

AMERICAN DOCTORAL DISSERTATIONS ON SCIENTIFIC AND MATHEMATICAL EDUCATION IN FOREIGN COUNTRIES

WALTER CROSBY EELLS
3700 Massachusetts Avenue, N.W., Washington, D. C.

THE writer has recently completed a study of some 15,000 doctoral dissertations in the field of education which have been accepted by American institutions of higher education. More than one thousand of these have dealt with various phases of education in foreign countries.*

Of the dissertations concerned with foreign education, at least 33 have been found which consider some aspect of education in science or mathematics in various countries. They are spread over a period of fifty years, the first one noted having been written in 1905. Almost half of them, however, have been written in the last ten years.

These dissertations have been accepted at 13 American universities, Columbia University leading with 18—more than half of the entire number. Iowa, New York, and Stanford are credited with two each and nine other institutions with one each.

Following is a list of the dissertations on education in the fields of science or mathematics in foreign countries, with name of author, title of dissertation, instituiton at which it was accepted, and date of acceptance.

NORTH AMERICA

Doucette, Andrew Leo, "A Science Program for Alberta Schools Based on Student Interests." Stanford University, 1950.

Flather, Donald M., "An Evaluation of the Science Program in the High Schools of British Columbia," University of Washington, 1950.

Grantham, Herbert H., "The Science Curriculum in British Columbia Schools with Emphasis on the Secondary Levels," Stanford University, 1951.

Joyce, Lester Douglas, "A Guide for Teachers of Arithmetic in Canadian Elementary Schools," Columbia University, 1949.

EUROPE

Abelson, Paul, "Seven Liberal Arts: A Study in Mediaeval Culture," Columbia University, 1906.

Boyer, James Alexander, "Thomas Huxley and His Relation to the Reorganization of Science in English Education," University of Michigan, 1949.

Clarke, Frances Marguerite, "The Influence of Thomas Simpson on the Progress and Development of Mathematics during the Century Following the Death of Newton," Columbia University, 1929.

Coleman, Robert J., "The Development of Informal Geometry," Columbia University, 1942. (In German schools)

Dudley, Fred Adair, "Matthew Arnold and Science," State University of Iowa, 1939.

* Titles of all dissertations in education and related fields have been examined in *Doctoral Dissertations Accepted by American Universities* (New York: H. W. Wilson Co., 1934–1954, 21 vols.); *Bibliography of Research Studies in Education* (Washington: United States Office of Education, 1929–1941, 13 vols.); W. S. Monroe's *Theses in Education Accepted by American Colleges and Universities* (Urbana: University of Illinois, 1920–1928, 6 vols.); *American Doctoral Dissertations Printed* (Washington: Library of Congress, 1912–1928, 27 vols.); and many other specialized bibliographies, catalogs, and abstracts of dissertations published by individual institutions and organizations. For a brief report of the general study, see Walter C. Eells, "American Doctoral Dissertations on Foreign Education," *Higher Education,* 12:19–22, October 1955.

Efron, Alexander, "The Teaching of Physical Sciences in Secondary Schools of the United States, France, and Soviet Russia," Columbia University, 1937.

Gade von Aesch, Alexander, "Natural Science in German Romanticism," Columbia University, 1941.

Hintz, Carl W. E., "Internationalism and Scholarship: A Comparative Study of the Research Literature Used by American, British, French, and German Botanists," University of Chicago, 1952.

Jackson, Lambert Lincoln, "The Educational Significance of Sixteenth Century Arithmetic from the Point of View of the Present Time," Columbia University, 1906.

Kilander, Holger Frederick, "Science Education in the Secondary Schools of Sweden: A Comparative Study of Sweden and the United States," Columbia University, 1941.

LeSourd, Gilbert Quinn, "The Place of Thomas Henry Huxley in Nineteenth Century Education," New York University, 1917.

Libby, Marguerite Sherwood, "The Attitude of Voltaire to Magic and the Sciences," New York University, 1935.

Meier, Lois, "Natural Science Education in the German Elementary Schools," Columbia University, 1930.

Moorman, Richard Herbert, "Some Educational Implications of Descartes' Synthesis of Mathematics and Philosophy," George Peabody College for Teachers, 1940.

Seip, William H., "Science Teaching in Secondary Schools in Prussia Since the Reorganization," Temple University, 1932.

Thorndike, Everett Lynn, "Place of Magic in the Intellectual History of Europe," Columbia University, 1905.

Turner, Ivan Stewart, "The Training of Mathematics Teachers for Secondary Schools in England and Wales and in the United States," Columbia University, 1939.

Williams, Leslie P., "Scientific Education in France during the Revolutionary and Imperial Periods, 1789–1815," Cornell University, 1953.

Wise, John E., "The Nature of the Liberal Arts," Fordham University, 1946.

Africa

Adegebite, Joseph A., "Science Education and Developmental Tasks of Nigerian Youth," Columbia University, 1954.

Kotb, Yusef Salal El-Din, "Science and Science Education in Egyptian Society," Columbia University, 1951.

Salem, Mohamed Mokhliss, "The Training and Attitudes of Egyptian Biology Teachers and American Science Teachers," Columbia University, 1953.

Zyl, Abraham J. Van, "Mathematics at the Cross-Roads: A Critical Survey of the Teaching of Mathematics in the Secondary Schools of the Union of South Africa, with Suggestions for Reorganization," Columbia University, 1940.

Asia

Ekasagdi, Kamolkan, "A Proposed Plan for the Implementation of Professional Laboratory Experience in the Pre-Service Secondary Student Teaching Program of the Division of Education, Royal University, Bangkok," Columbia University, 1953.

Khalid, Abdulrahman, M., "Science Education in Iraqui Society," Columbia University, 1954.

Lee, Sookney, "Primary Arithmetic Textbooks in Korea, Japan, China, and the United States," State University of Iowa, 1954.

Sayli, Aydin Mehmet, "The Institutions of Science and Learning in the Moslem World," Harvard University, 1942.

Twiss, George Ransom, "Science and Education in China: A Survey of the Present Status and Program for Progressive Improvement," Columbia University, 1926.

Wardwell, Wayne Doran, "An Educational Program for Technical High Schools in India," Ohio State University, 1950.

KENNETH B. M. CROOKS

Dr. Kenneth B. M. Crooks an enthusiastic member of the National Association for Research in Science Teaching passed away January 20 as the result of a heart attack. Only three weeks earlier his N.A.R.S.T. friends and acquaintances had heard his paper presented at the N.A.B.T.-A.A.A.S. meeting in Washington, D. C.

Dr. Kenneth B. M. Crooks was born in Hanover, Jamaica, British West Indies, May 25, 1905. At the age of nine he was the winner of the British Empire's Comprehensive Elementary School Examination competition. When he was 11, he won the British West Indies Competitive Examination for admission to Jamaica College, a college preparatory school for boys. He earned A.B., A.M. and Ph.D. degrees from Harvard University in 1927, 1928, and 1940 respectively. During 1937–38 he was a General Education Board Fellow at Harvard University. While at Harvard during his undergraduate days, he was a member of the Harvard Varsity soccer team and was named center-forward on the 1927 All-American Soccer team.

Dr. Crooks was a laboratory assistant in botany while working on his advanced degrees. He was instructor, assistant professor, associate professor, and professor of biology at Hampton Institute, Virginia from 1928–33, 1933–35, 1935–39, and 1939–41. He served as Headmaster of the Happy Grove College, Hectors River, Jamaica from 1941 through 1953. Only last fall he had returned to Happy Grove College to participate in a special dedicatory service and a tangible realization of his dreams. His untiring efforts as a member of several boards and commissions in Jamaica were instrumental in re-shaping the educational philosophy of that island. In 1953 Dr. Crooks became professor and head of the zoology department at Fort Valley State College, Fort Valley, Georgia. He left Fort Valley State College in 1957 to become a member of the staff of Grambling College, Grambling, Louisiana.

Membership in organizations included: member and Fellow in the American Association for the Advancement of Science, Association of Physical Anthropology, Entomology Society of America, Virginia Academy of Science, Natural History Society of Jamaica, Virginia Society for Research, National Institute of Science, Science Masters Association of England, Science Teachers Association of Jamaica, Beta Kappa Chi (honorary), National Association of Biology Teachers, American Institute of Biologists, and the National Association for Research in Science Teaching. He is listed in *American Men of Science* and served as vice-president of the Science Teachers Association of Jamaica, 1951–53.

Titles of his master's thesis are: "The Status of Regeneration in Animals" and "On the History of the Banana," Harvard University, 1928. His doctoral study at Harvard (1940) is entitled "The Effect of Attrahents on Mosquitoes With Special Reference to Oviposition in Four Common Species." Publications include: *The Golden Jubilee of Happy Grove*, Kingston, Jamaica; co-author (with three others): *Laboratory Directions in General Biology*, Hampton Institute, 1938, 1940.

Publications in magazines total more than thirty and include the following magazines: *Science Education, Journal of Negro History, Science, Journal of Parasitology, Journal of Negro Education, American Journal of Physical Anthropology, Human Biology, The American Biology Teacher, The Echo, Jamaica Calling, Jamaica Gleaner, American Friend Negro History Bulletin, Penn Weekly, Public Opinion, Southern Workman,* and *Virginia Journal of Education.*

Dr. Crooks married Nella Edgar in St. Phillips Church in New York City, June 1, 1929. Children born to this union are: Mrs. Cynthia May Carpenter of Hales Corner, Wisconsin. Mrs. Carpenter graduated from Earlham College, Richmond, Indiana, and is the mother of two children. Kenneth B. M. Crooks, Jr. graduated from the University of Massachusetts and has recently completed a two-year tour of duty in the army. Sylvia Crooks is a graduate nurse from the North Middlesex College Hospital in England and is presently serving in the Air Force Hospital, Frankfurt, Germany. Nella Crooks is a graduate of the University of Massachusetts, worked in the Harvard Medical School, and is presently doing graduate study at St. Vincent's Hospital, Worcester, Massachusetts. Also surviving is Dr. Crook's mother (83) and a sister Mrs. Lucille Clarke living in Jamaica.

Dr. Crooks was a member of the Religious Society of Friends (Quaker) and a minister in the Quaker faith. He was very active in church work and the Young Men's Christian Association, as well as in community affairs.

The Grambling College paper in a tribute to Dr. Crooks, among other comments, had this to say:

> The untimely passing of Dr. Kenneth B. M. Crooks recently was a serious loss to the academic calm and intellectual and cultural progress at

Grambling College. Although a relative newcomer to the institution and the community, Dr. Crooks had with diligent concern and untiring energy, made himself a solid pillar in educational, religious, and civic endeavors in this area.

A fine example of the scholar in the great tradition, he was none the less always busy with the practical needs of the school and the community.

Students who had the privilege of sitting at his feet and serving in organizations under his leadership and his urging must have certainly obtained new inspiration to lead progressively better lives. . . .

He gave freely of his time and thinking with every student and every staff member. He enjoyed the highest respect of everyone because he never gave less than the best to every one. Quickly had his extensive training, wide experience, and broad culture become felt in the life of the college and the community. In this regard, therefore, he will live long among us as a great character to be emulated and as a great spirit by which to be challenged.

N.A.R.S.T. friends and acquaintances affirm this eulogy paid to Dr. Kenneth B. M. Crooks.

CLARENCE M. PRUITT

RICHARD RALPH ARMACOST

It is with regret that we report the death of Dr. Richard Ralph Armacost co-editor of *The American Biology Teacher* and professor at Purdue University, Lafayette, Indiana. He was killed in an automobile accident February 26 while on his way to Indianapolis. Survivors include his wife, Mrs. Katherine Armacost, two daughters, Miss Betsy R. Armacost at home and Miss Susan Armacost at Syracuse, New York, and his parents, Mr. and Mrs. Charles Armacost of Cincinnati, Ohio.

Dr. Armacost was born in St. Bernard, Ohio, February 27, 1914. He earned an A.B. degree from Miami University, Oxford, Ohio in 1936 and M.S. (1938) and Ph.D. (1940) degrees from the University of Iowa, Iowa City, Iowa.

Teaching experience included: Assistant in Botany, University of Iowa, 1936–40; Dual Professor of Science and Education, Syracuse University, Syracuse, New York, 1940–50; Purdue University, 1950–59.

He was President of the New York State Science Teachers Association, 1942–43. Membership in organizations included: Botanical Society of America, Sigma Xi, Phi Delta Kappa, National Association of Biology Teachers, Kappa Phi Kappa, and National Science Teachers Association. He was a former member of the National Association for Research in Science Teaching. He is listed in *Leaders in Education* and *American Men of Science.*

Dr. Armacost became co-editor with Paul Klinge of *The American Biology Teacher* in 1954. With the assistance of Managing Editor, Muriel Beuschlein, they built *The American Biology Teacher* into an outstanding professional magazine in the teaching of biology, proudly sponsored by the National Association of Biology Teachers. The enthusiasm and contributions of Dr. Armacost will be very much missed in editing *The American Biology Teacher,* in N.A.B.T. affairs, and as a science education leader.

CLARENCE M. PRUITT

WARREN W. McSPADDEN

Warren W. McSpadden, age 55, passed away March 12, 1959. He had been for many years general manager and assistant treasurer of the American Society for the Prevention of Cruelty to Animals. Formerly he had been supervisor of science in the public schools of Austin, Texas and later taught science at Teachers College, Columbia University. Many NARST members and especially elementary science teachers will recall his earlier interest in, and contributions to the elementary science field.

BOOK REVIEWS

DALGLIESH, ALICE. *The 4th of July Story.* New York (597 Fifth Avenue): Charles Scribner's Sons, 1956. Unpaged. $2.75.

This is a story of the most important of all American National holidays—the Fourth of July. Chronological and technical details are omitted. The story is suitable for third and fourth graders. There are pictures in color by Marie Nonnast. The book is recommended for the school library.

DALGHIESH, ALICE. *Ride on the Wind.* New York (597 Fifth Avenue): Charles Scribner's Sons, 1956. Unpaged. $2.75.

Ride on the Wind is a children's edition of Lindbergh's *The Spirit of St. Louis.* Lindbergh himself checked it for accuracy. The writer, to a high degree, captured the spirit found in the original. To many present day children Lindbergh is either totally unknown or a legendary character. Even many adults of the twenties have to a large extent forgotten the thrilling flight of The Spirit of St. Louis—truly a heroic flight in the development of aviation.

Pictures in color are by Charles Schriber. The book is suitable for and recommended for intermediate graders.

SCHLOAT, JR., G. WARREN. *The Magic of Water.* New York (597 Fifth Avenue): Charles Schribner's Sons, 1955. Unpaged. $2.50.

Water is a truly magical, wonderful substance. Without it plants, animals, and people could not live. This book tells how Andy found out about the magic of water. It tells where water comes from, what it does for you, experiments you can do with it, how to conserve it, how much water a tree, a chicken, a dog, and you use in a week. Numerous fine photographs by the author supplement the textual material.

The book is suitable for six-to-ten year olds and is recommended for the elementary science library shelf.

GOUDEY, ALICE E. *Here Come the Deer.* New York (597 Fifth Avenue): Charles Scribner's Sons, 1955. 94 P. $2.25.

In an interesting, delightfully told story, the author describes the growth and development of a young Whitetail Deer, an Elk, and a Caribou. Each are described from their moment of helplessness after birth until they reach maturity. She describes their homes, wanderings, food habits, and enemies.

Much valuable information is given about each of these once fast disappearing animals. The material was checked for accuracy by Lee S. Crandell, General Curator Emeritus of the New York Zoological Society. Numerous illustrations in color add to the interest of the story and the beauty of the book. This is recommended as a fine book for the middle grades elementary science book shelf.

GOUDEY, ALICE E. *Here Come the Whales.* New York (597 Fifth Avenue): Charles Scribner's Sons, 1956. 94 P. $2.50.

Whales are interesting, dramatic, and exciting. They are mammals and the largest animals that ever lived on land or in the sea. Some blue whales are over a 100 feet long and very large ones have weighed as much as 150 tons. This book describes the life story of blue and sperm whales as they rove the seas from pole to pole.

There are illustrations in color by Garry MacKenzie.

This is a fine book for the elementary science book shelf and for readers of upper intermediate and grammar grade level.

POLITI, LEO. *The Butterflies Come.* New York (597 Fifth Avenue): Charles Scribner's Sons, 1957. Unpaged. $2.75.

Stephen and Lucia lived on the Monterey peninsula in California. Here they learned to know and love many woodland creatures—deer, squirrels, butterflies. The story is centered about the return each year of Monarch butterflies who come to spend the winter in the same grove of butterfly trees. Each year there is a gay butterfly parade.

The facts about the Monarch butterflies are true. They are found in all parts of the United States. In the fall they migrate from the north to a warmer climate.

Pictures in color are by the author. The book is suitable for primary children and the primary grade bookshelf.

KONO, KEOKA, AND MULGRAVE, DOROTHY. *The Hidden Village.* New York (55 Fifth Avenue): Longmans, Green and Company, 1954. $2.50.

This is an adventure story of Hawaii. Keo, a Hawaiian boy, is alert beyond his years and even his mother does not believe the story of his fight with an octopus. Leo finds the hidden village of the Menehune the pigmy, who are about two feet or so high. They are noted for their feats of strength and peaceful pursuits. Keo is tried by the Menehune as a spy, but is found not guilty.

When a powerful enemy from an island to the south invades the island, Keo, with the help of the Menehune, is an important factor in saving his people.

The story is based on one of the many legends of the Hawaiian Islands. Miss Kono is a native of Honolulu and Miss Mulgrave is

professor of education in New York University. This is a fine story for upper grammar grade-junior high school pupils.

WILLIE, PRISCILLA D. *The Race between the Flags.* New York (55 Fifth Avenue): Longmans, Green and Company, 1955. 177 P. $2.50.

Steeplechasing is often called "racing between two flags," hence the title of this book. It is the story of Alfred and the Saint. Readers may recall the earlier story of The Saint. Aided by Only, the lame stable boy, Alfred has had many heartaches and disappointments as he trains the former show horse for the big steeplechase. But Alfred does lead The Saint to the winner's circle at the Big Steeplechase to everyone's surprise except Alfred and Only.

This is a fine story about the training of horses and racing stables and a grand champion The Saint. Boys and girls will thoroughly enjoy this new adventure of The Saint.

RUSH, WILLIAM MARSHALL. *Lumberman's Dog.* New York (55 Fifth Avenue): Longmans, Green and Company, 1955. 244 P. $3.00.

This is the story of the intense love of the woods and streams and all the creatures near timberline country by Ken Rogers, recently graduated forester. Forestry to Ken meant growing trees as a crop, not "mining" them.

Ken gets a job estimating timber resources for a railroad magnet. Along with this job Ken has to take care of Wrecker a highly valuable terrier whose disposition had been ruined by cruel treatment. The story centers around a sheepherder's opposition, a moonshiner's gang, a forest fire, winning Wrecker's confidence as well as that of the railroad magnet.

Altogether this is a most readable adventure story of forestry work, a story sure to please many boys.

BATE, NORMAN. *Who Built the Bridge?* New York (597 Fifth Avenue): Charles Scribner's Sons, 1954. Unpaged. $2.50.

This is the story of how New Bridge was built and what happened to Old Bridge across Big Sleepy. In the story the bridge talks, but has no other human characteristic. The story shows all of the steps in the building of a bridge, with suspense rising as the river rises and the bridge is not quite finished. Illustrations in color are by the author.

Boys and girls will learn much about building a bridge from this interesting book. It is suitable for upper grammar grade-junior High School level students.

DALGLIESH, ALICE. *The Thanksgiving Story.* New York (597 Fifth Avenue): Charles Scribner's Sons, 1954. Unpaged. $2.50.

This is a book to read aloud to children when they first want to know why we have Thanksgiving Day. Children a little older can read it themselves.

The story tells of one family on the Mayflower, of their hardships on the voyage and during their first Winter. It tells, too, of the joy in the arrival of the new baby, of Spring in their new home, of planting, harvest, and the first Thanksgiving.

Gay illustrations in color by Helen Sewell add much charm and interest in the book.

This is an excellent book for the primary grades book shelf.

RENICK, MARION. *Todd's Snow Patrol.* New York (597 Fifth Avenue): Charles Scribner's Sons, 1955. 123 P. $2.00.

Alabama born Todd Tracy moved North where he had never seen snow. When Winter came, Todd wanted to ski like the other boys and girls in his class. With great enthusiasm and much effort Todd learned to ski and became a part of the Queen's Snow Patrol.

This story centered around skiing will be enjoyed by boys and girls developing an interest in this Winter sport. In itself, the story is delightful reading for many other youngsters.

HAMILTON, RUSSELL. *The First Book of Trains.* New York (699 Madison Avenue): Franklin Watts, Inc., 1956. 69 P. $1.95.

This First book takes its readers behind the scenes of diesel-electric locomotives and tells the

story of cars, tracks, switches, signals and stations. It also tells of the men and women who run them. It answers such questions as: Who's the boss of the train, Why are there so many different cars, What do the signals mean, Who keeps track of all trains running at the same time, How are trains put together, Who's who at the station, What happens when I ride on a train?

Running trains today is a truly intricate operation. Most boys and men at one time or another in their lives have wanted to run a train.

There are unusually fine illustrations in color by Jeanne Bendick.

EPSTEIN, SAM, AND BERYL. *The First Book of Glass.* New York (699 Madison Avenue): Franklin Watts, Inc., 1955. 65 P. $1.95.

Glass is one of the oldest and one of the most useful things man makes. Once it was so rare that only royalty could afford it. Now glass is made in such quantities and for such a variety of purposes that we almost take it for granted, but in many parts of the world it still remains a luxury.

This book presents something of the history of glass making and how glass was made in the past as well as at present. Pictures in color by Bette Davis add much to the understanding of glass making and the many kinds and uses of glass.

ICENHOWER, J. B., CAPT. U. S. N. *The First Book of Submarines.* New York (699 Madison Avenue): Franklin Watts, 1957. 62 P. $1.75.

This *First Book* explains in story and through pictures by Mildred Waltrip how a submarine works. Submarines have been of great interest and importance ever since World War I. The first underwater ship was built in England 1620. Today Russia leads the world in the number of submarines, building about 100 submarines a year. The United States has two atomic-powered submarines in operation.

Elementary science teachers and young readers will find this book unexcelled as an introduction to submarines—their history, construction, and operation.

ICENHOWER, J. B. *The First Book of the Antarctic.* New York: 699 Madison Avenue. Franklin Watts, Inc. 68 P. $1.95.

There are more than 2,000,000 First Books in print, attesting to the great popularity of the series. The First Books have a steady and increasing sale to adults seeking a genuine *beginning* on a subject.

The whole series is fully illustrated with over 100 colorful pictures. All of the books have been checked and double-checked for accuracy, authority, and clarity of text.

The First Book of the Antarctic takes us down to the bottom of the world and the last explored country of the world—Antarctic. Presently scientists, engineers, technicians and explorers from eleven different countries are in Antarctica seeking new facts.

Captain Icenhower, U. S. Navy, was a member of the U. S. Navy's Antartic expedition in 1946–47. It is a land of strange and fascinating animals, terrible storms, treacherous ice packs and whaling fleets.

WILLIAMSON, MARGARET. *The First Book of Mammals.* New York (699 Madison Avenue): Franklin Watts, 1957. 63 P. $1.95.

This is another of the widely acclaimed *First Books.* Scientifically accurate and crammed with arresting facts and pictures, this book is a splendid introduction to the world of animals. Mammals live almost everywhere.

Readers will recall the author's earlier *The First Book of Birds* and *The First Book of Bugs,* both books highly recommended by authorities in natural history.

This is an excellent book for elementary science teachers and for upper grammar grade—Junior high school boys and girls.

AGLE, NAN HAYDEN, AND WILSON, ELLEN. *Three Boys and a Mine.* New York (597 Fifth Avenue): Charles Scribner's Sons, 1954. 122 P. $2.00.

This is the fourth of the lively stories about the look-alike triplets Abercrombie, Benjamin, and Christopher, and their dog John Paul Jones.

In this story the triplets take a trip, visit an anthracite coal mine, and learn about the work of coal miners. The conversational style makes for easy, interesting reading for middle-graders.

This is a very good book for supplementary reading about the middle grade level. Boys and girls will thoroughly enjoy the delightfully told story.

BROWN, MARGARET WISE: *Young Kangaroo.* New York (8 West 13th Street): William R. Scott, Inc., 1955. Unpaged. $2.25.

This is a factually accurate and fascinating story about the growth and development of a young kangaroo. Unusually attractive drawings in color by Symeon Shimin add much to the general appeal of the book.

The book is recommended for the primary grades.

BROWN, MARGARET WISE. *Big Red Barn.* New York (8 West 13th Street): William R. Scott, Inc., 1956. Unpaged. $2.25.

Big Red Barn is about a day in the life of familiar animals on the farm. There are appealing pictures in color by Rosella Hartman. The book is recommended for the first grade.

SCHLEIN, MIRIAM. *It's About Time.* New York (8 West 13th Street): William R. Scott, Inc., 1955. Unpaged. $2.00.

This "concept" book answers many questions about time, including how to tell it. The book is designed to make children *think* about time. There are colored illustrations by Leonard Kessler. The book is suitable for the primary grades.

SCHLEIN, MIRIAM. *Little Rabbit the High Jumper.* New York (8 West 13th Street): William R. Scott, Inc., 1957. Unpaged. $2.25.

This delightful story of Little Rabbit and Mother Rabbit stresses the close relationship between mother and child—rabbit or human.

The beautiful illustrations in color by Theresa Sherman portray this relationship visually.

Most children love rabbits and stories about rabbits. Six and seven year olds will spend many a delightful hour re-reading this story and looking at the gay pictures.

SCHLEIN, MIRIAM. *Big Talk.* New York (8 West 13th Street): William R. Scott, Inc., 1955. Unpaged. $2.25.

Big Talk is the story of a young kangaroo as it rapidly develops into a big animal. The attractive pictures in color are by the author's husband Harvey Weiss. This is a fine book for first graders.

SCHLEIN, MIRIAM. *Lazy Day.* New York (8 West 13th Street): William R. Scott, Inc., 1955. Unpaged. $2.00.

Every once in a while there are days when nobody hurries, nobody rushes, and nothing much gets done, but every one has a lazy day. Lazy days come to both people and animals. Illustrations in color are by the author's husband Harvey Weiss. The book will be enjoyed by first and second graders.

GARELICK, MAY. *What's Inside?* New York (8 West 13th Street): William R. Scott, Inc., 1955. Unpaged. $2.00.

What's Inside is the story of the hatching of a goose egg and the early life of a gosling. The actual photographs and pertinent, readable textual material make this an unusually fine book for first and second graders. Through photographs a child can see exactly how young hatch from an egg.

CHARLIP, REMY. *Where Is Everybody?* New York (8 West 13th Street): William R. Scott, Inc., 1957. Unpaged. $2.25.

Here is a new kind of easy reader for the beginner. Through the clever use of drawings the child learns one concept at a time. One sentence is found on each double-page. Visual association of the objects with the word should help children to learn to read and add interest in the story they are reading. Illustrations are by the author. Many teachers of beginning reading utilize the idea illustrated in this attractive book for beginners.

SAGE, JUNIPER, AND BALLANTINE, BILL. *The Man in the Manhole and the Fix-It Men.* New York (8 West 13th Street): William R. Scott, Inc., 1956. Unpaged.

Small children are often fascinated by "fix-it" men and their work. Many of these "fix-it" men appear in this story as well as being pictured in color.

The book is suitable for primary grade children who will enjoy the pictures as well as the reading material.

MCGAW, JESSIE BREWER. *How Medicine Man Cured Paleface Woman.* New York (8 West 13th Street): William R. Scott, Inc., 1957. Unpaged. $2.75.

The unique value of this book is that it is written entirely in real American Indian pictographs. This is a story told in the oldest form of writing the world has known. Many of the pictographs in the book are such simple symbols that they are almost self-explanatory and can be "read" on sight once you get the "hang" of the language.

The English translation is printed under each pictograph in large, clear manuscript writing making an unusually fine easy-reader.

The pictograph story tells how one winter a lost, sick paleface woman was discovered by Indians, brought to their camp, and cured by their Medicine Man.

This is an especially fine book for six-to-nine year olds.

BURNETT, BERNICE. *The First Book of Holidays.* New York (699 Madison Avenue): Franklin Watts, Inc., 1955. 63 P. $1.95.

The First Book of Holidays is one of the very famous Watts First Books so widely acclaimed by science teachers and educators everywhere. This book lives up to the excellence of its predecessors. There is interesting information about our American holidays. Gay pictures in color and black and white by Marjorie Glaubach complement the simple, well written text.

This is Mrs. Burnett's first book and a fine job it is! She is the wife of Professor R. Will Burnett, well known N.A.R.S.T. member and science education leader.

The book is highly recommended for the elementary science book shelf.

WYLER, ROSE. *The First Book of Weather.* New York (699 Madison Avenue): Franklin Watts, Inc., 1956. 63 P. $1.95.

The First Book of Weather is an unusually fine book on weather. The book answers many questions and explains what makes the weather. There are numerous, simple experiments and directions for making weather instruments, read-

ing weather maps, and making forecasts. Two-color drawings and illustrations are a most essential part of the book.

This book is about the finest introduction to weather beginners can find any place. It should be on every elementary science book shelf.

Miss Wyler (in private life Mrs. Gerald Ames) is a noted science writer and former science teacher.

SMITH, F. C. *The First Book of Conservation.* New York (699 Madison Avenue): Franklin Watts, Inc., 1954. 69 P. $1.95.

Conservation is an important problem to each American that has any interest in the present or future of America. Each one can take a constructive part and attitude toward all conservation problems.

Rivers, lakes, forests, wildlife, the green growing plants, the earth itself, and human beings are in close intricate interrelationships.

Conservation needs to be an important aspect of the education of every boy and girl. Too many people are either not interested in any phase of conservation or only in some particular phase that affects them individually. Actually conservation is, or should be, everyone's problem and interest—all phases of it. Storm, dust, drought, and flood are all wasters of the earth's resources, but the greatest waster is man himself, largely through thoughtless or even intentional exploitation and waste.

This is an excellent first book on conservation. Pictures in color are by Rene Martin.

HAMILTON, ELIZABETH. *The First Book of Caves.* New York (699 Madison Avenue): Franklin Watts, Inc., 1956. 63 P. $1.95.

Caves are exciting, mysterious, and beautiful. They were probably the first permanent home of man. During the last glacial period men lived in the caves of France where evidences of their habitation and art are found. Strange animals inhabit caves.

Five principal kinds of caves are: wind, wave, lava, ice, and limestone caves. Many famous caves are found around the world. Caves in the United States include Mammoth, Carlsbad Caverns, Wind Cave, Craters of the Moon, and so on. The record ground penetration in caves was a point 2,963 feet beneath the ground surface near Grenoble, France.

A list of safety rules for spelunkers is included.

PERRY, JOHN. *Our Wonderful Eyes.* New York (330 West 42nd Street): Whittlesey House, McGraw-Hill Book Company, 1955. 158 P. $2.75.

Our eyes are indeed wonderful and just as we don't appreciate good health until we have poor health, so we don't appreciate our eyes until something is the matter with them. Fascinating is about the only word that describes this most interestingly written book. It is literally packed with all sorts of information greatly abetted by the illustrations of Jeanne Bendick which explain difficult concepts in a simple, graphic way.

There is much about light and color in this book, too. There is a chapter on what animals see. The book is replete with experiments and demonstrations that an individual or a group can do—requiring only very simple materials, or none at all.

This book is recommended as an outstanding book for the science library—elementary school, Junior high, or secondary, and for the elementary school and the general science teacher.

POOLE, LYNN. *Science the Super Sleuth.* New York (330 West 42nd Street): Whittlesey House, McGraw-Hill Book Company, 1954. 192 P. $2.75.

Science is the chief tool used in combatting crime and is the most deadly foe criminals have to face. Science helps law enforcement officials to solve criminal cases and bring to justice thousands of wrong-doers each year. Science makes the "perfect crime" practically impossible. In this book, the author describes some of the numerous ways science is used in crime detection. The material is based upon numerous interviews with noted criminal investigators and has been checked for accuracy by experts in crime detection. Science is the friend of the innocent and the arch-enemy of the guilty.

The author describes numerous ways science is used in criminal investigation, illustrated by numerous case histories. The book is interestingly written and illustrated. Many readers will recall Poole's earlier books *Today's Science and You* and *Your Trip Into Space.* He is producer of the Johns Hopkins TV Science Review. Teenage boys will especially appreciate this book. It is unfortunate that all potential would-be criminals, delinquents, and actual criminals cannot have access to this book. It might serve as an effective deterrent for their law-breaking inclinations.

COOK, BERNADINE: *The Little Fish That Got Away.* New York (8 West 13th Street: William R. Scott, Inc., 1956. Unpaged. $2.25.

Here's a book that first graders will have a lot of fun reading and looking at the pictures. Its a good fish story! The illustrations in color are by Crockett Johnson.

KLEIN, LEONORE. *What Would You Do If.* New York (8 West 13th Street): William R. Scott, Inc., 1956. Unpaged. $2.25.

Each of the three people in the book reacts according to his own image of the kind of person he would like to be. The boy takes it as a joke, the little girl looks for protection, and the man reacts with bravado. But what would you do? Children will enjoy this book, suitable for six-to-nine year olds. Illustrations are in color by Leonard Kessler.

The children will make a game out of other "What Would You Do?"

Selsam, Millicent: *How the Animals Eat.* New York (8 West 13th Street): William R. Scott, Inc., 1955. 91 P. $2.50.

All animals must eat to live. And each one has special equipment to help him get the particular kind of food he needs. Some animals are equipped to eat nothing but green plants. Others have special equipment to hunt and eat these plant-eaters. And some hunters are equipped to catch and eat these hunters. No one really knows how the animals got their special equipment for eating.

This book describes the special eating equipment of many different kinds of animals. Illustrations in color are by Helen Ludwig.

This is an excellent book for nine-to-thirteen-year-olds or for the science book shelf.

Cook, Bernadine. *The Curious Little Kitten.* New York (8 West 13th Street): William R. Scott, Inc., 1957. Unpaged. $2.25.

This story is about a kitten who sees a turtle for the first time and doesn't know what to make of him. There are a lot of surprises in the story which will be much enjoyed by children. The curious kitten learns a lesson and children see that different animals enjoy entirely different living conditions.

Black and white illustrations by Remy Charlip add much interest and understanding to the textual material.

The book is recommended for six-to-eight year olds.

Colby, Jean Poindexter. *Jenny.* New York (41 East 50th Street): Hastings House, Publishers, 1957. 44 P. $2.50.

This is a true dog story. Jenny was a dog the Clark family picked up at an animal hospital in Boston. A mongrel, Jenny turned out to be very smart. Children will thoroughly enjoy listening to or reading about the extraordinary Jenny.

This is a fine book for primary grade children and the primary book shelf.

Stroddard, Edward. *The Story of Power.* Garden City, New York: Garden City Books, 1957. 63 P. $2.00.

What makes things go—power—is the theme of this book. It tells about sources of power, the first engines, water, wind, steam, gas engines, diesels, electricity, power from the sun, jets and rockets, and atomic power. Illustrations in color are by Lee Ames.

The book is intended for 8- to 14-year-olds, but it would be an exceptional 8-year-old who could read the book with desirable understanding.

Gallant, Roy A. *Exploring the Universe.* Garden City, New York: Garden City Books, 1956. 62 P. $2.00.

Only once in a very great while does such a fascinating book at such a low price come along. This applies especially to the color illustrations by Lowell Hess. Altogether this is one of the very finest introductions to the universe a reader can find anyplace. It is recommended as a fine reference book, excellent for the science library, and for the elementary science teacher. If you can be lifted into the vastness of size and distance, this is the book that can do it!

Discussed are such ideas as the Ptolemaic and Copernican Concepts of the universe or solar system, the constellations, movements of the solar system, our galaxy, other galaxies, meteors, kinds and sizes of stars, our expanding universe, and so on.

Gallant, Roy A. *Exploring Mars.* New York (575 Madison Avenue): Garden City Books, 1956. 62 P. $2.00.

The most studied planet in the solar system (outside the earth) is Mars. This is true because it is near enough to the earth to encourage investigation, its position is most favorable, and its atmospheric conditions permit investigation. Yet for all of this Mars is still a mystery planet. During 1956 Mars was the most investigated planet of all times—possibly the time spent during 1956 was more than that spent in all previous history, or in all of the investigations devoted to all of the other planets combined. On September 7, Mars approached to within some 35 million miles of the earth and was in a most favorable position to study.

This book explores the many interesting theories about various aspects of Mars—the "canals," plant and animal life, atmosphere, water, temperature, seasons, motions, moons, physical conditions, origin, and so on. Many unusually fine illustrations in color are found throughout the book.

This is a fine book for boys and girls 8 to 14 years of age. It would make an excellent addition to the science book shelf.

Bevans, Michael H. *The Book of Reptiles and Amphibians.* New York (575 Madison Avenue): Garden City Books, 1956. 62 P. $2.50.

This book for upper grammar grade level through second year high school young people presents over 100 species with adequate, accurate description, and in beautiful colors.

The book is recommended for the science shelf as an excellent general reference for pupils and teachers. It will serve as a fairly adequate guide for identification.

SCHWARTZ, JULIUS. *I Know a Magic House.* New York (330 West 42nd Street): Whittlesey House, McGraw-Hill Book Company, 1956. 32 P. $2.00.

Magic is found in every house! Here a little boy finds magic in the water from the mountain, the kitchen, telephone, electric light, radio, television, refrigerator, electric toaster, the steam radiator, the food, soap bubbles, the clock, the scales, and the thermometer. Come to think of it, these are all truly magic!

Pictures in color by Marc Simont are a most important part of this book recommended for primary grades.

ANTONACCI, ROBERT J., AND BARR, JENE. *Baseball for Young Champions.* New York (330 West 42nd Street): Whittlesey House, McGraw-Hill Book Company, 1956. 156 P. $2.75.

This is a handbook for young baseball players, the Little Leaguer, or any beginner. It discusses the equipment and layout, keeping score, how to play infield and outfield position, catching and pitching positions, how to bat, how to pitch, and so on. The book is diagrammatically illustrated. There is an introduction by Yogi Berra who praises the book very highly.

This is surely a fine book for the beginning baseball player (and amateur managers, too!)

TODD, MARY FIDELIS. *ABC and 1, 2, 3.* New York (330 West 42nd Street): Whittlesey House, McGraw-Hill Book Company, 1955. Unpaged. $2.00.

In a beautifully illustrated book in color, boys and girls learn to count and to know their A, B, C's. They also learn about many things they might do when they grow up. Children will delight in learning the rhymes and counting the number of things in each picture. This is a fine book for beginning first grade children.

BLOUGH, GLENN O. *After the Sun Goes Down.* New York (330 West 42nd Street): Whittlesey House, McGraw-Hill Book Company, 1956. 48 P. $2.50.

After the Sun Goes Down is the story of animals at night. While we and many animals sleep, many animals are most active. Some are searching for food, building homes, taking care of young, producing their own characteristic sounds. In this book are whippoorwills, screech owls, mice, flying squirrels, opossums, brown bats, crickets, katydids, frogs, insects, and beavers.

The book is beautifully illustrated by Jeanne Benedick.

Earlier Blough books published by Whittlesey House include *Lookout for the Forest, Not Only for Ducks, Wait for the Sunshine,* and *The Tree on the Road to Turntown.* Each of the Blough books is highly recommended for the elementary science book shelf.

Continued from inside front cover